S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing Report

1335-1355 PLAINS ROAD EAST

CITY OF BURLINGTON

DVLP PROPERTY GROUP

December 2017
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SLA File: 17112

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by DVLP Property Group to provide consulting engineering services for the proposed development at 1335-1355 Plains Road East in the City of Burlington (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of demolishing four buildings and constructing 38 townhouse units within 3 blocks. The development will also include landscaped areas, asphalt parking/driveways and a single access point.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the preliminary site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by Chamberlain Architect Services Ltd. for additional information.

1.2 BACKGROUND INFORMATION

The following documents were referenced in the preparation of this report:

Ref. 1: MOE Stormwater Management Practices Planning and Design Manual (Ministry of Environment, March 2003)

Ref. 2: City of Burlington Standard Drawings (City of Burlington, March 2004)

Ref. 3: Halton Region Water and Wastewater Linear Design Manual (Halton Region, May 2014)

Ref. 4: Erosion & Sediment Control Guidelines for Urban Construction (December 2006)

Ref. 5: Geotechnical Investigation, Proposed Residential Development 1335, 1349, 1355 Plains Road East, Burlington, Ontario. (Sola Engineering December 6, 2017)

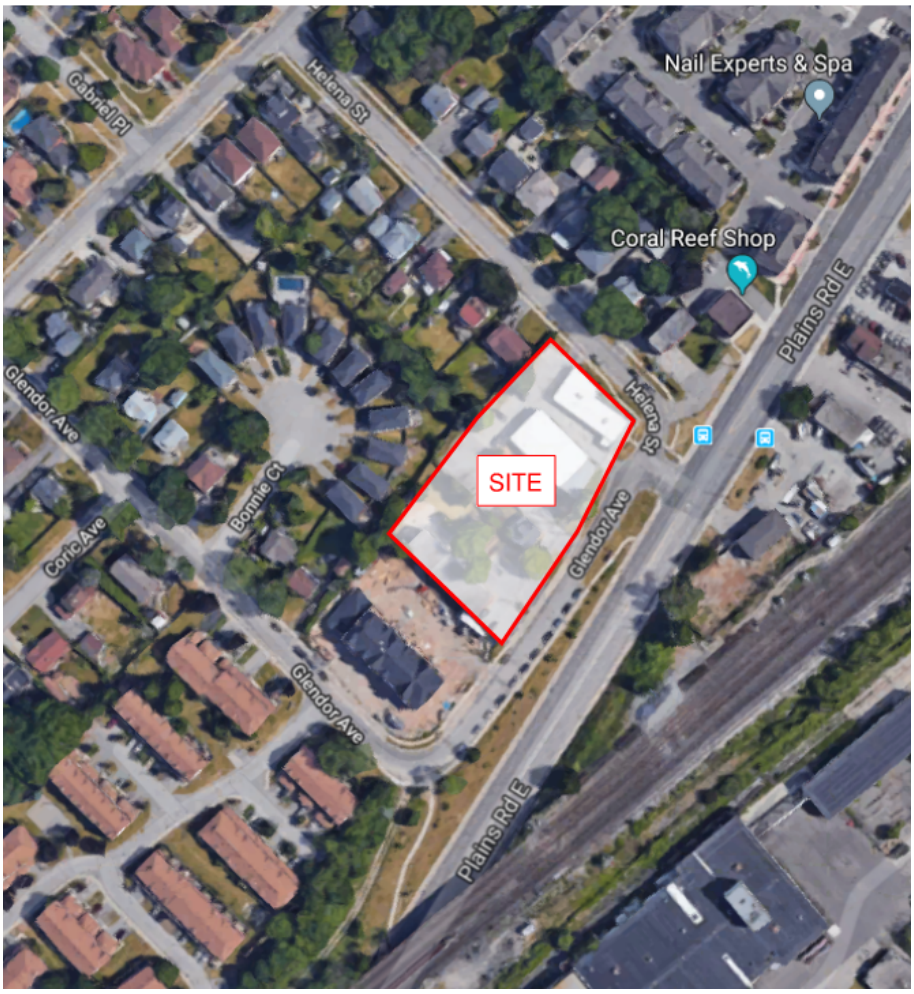


Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Burlington:

Quantity Control
The stormwater discharge rates in the post-development condition will not exceed the 5-year discharge rate in the pre-development condition.

Quality Control
The stormwater runoff from the post-development must meet Level 1 (Enhanced) stormwater quality control (80% TSS removal, 90% average annual runoff treatment)

Erosion Control
Erosion and sediment control measures will be implemented in accordance with the standards of the City of Burlington.

2.1 PRE-DEVELOPMENT CONDITIONS

In the pre-development condition, the 0.46 ha site contains 4 existing buildings with associated asphalt driveways/parking lots. The site is bound by existing residential lands to the north and west, Helena Street to the east and Plains Road East to the south.

There is an existing 975mmø storm sewer along Helena Street, an existing 750mmø storm sewer along Plains Road and an existing 450mmø storm sewer within an easement through the subject lands, all ultimately discharging to the existing 1.8m x 1.2m box culvert crossing Plains Road East.

One catchment area, Catchment 101, has been identified in the pre-development condition. Catchment 101 represents the area of the entire site that drains to the existing culvert crossing Plains Road East. See Table 2.1 below and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.1- Pre-Development Catchment Areas

Catchment ID	Description	Area (ha)	% Imp.	Runoff Coefficient
101	To Plains Road	0.46	81	0.79

An analysis was performed on Catchment 101 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington Design Storms. A summary of the results can be found in Table 2.2 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.2 - Pre-Development Condition Site Discharge

Storm Event	Catchment 101 Discharge (m^3/s)
2-Yr Event	0.082
5-Yr Event	0.108
10-Yr Event	0.124
25-Yr Event	0.146
50-Yr Event	0.161
100-Yr Event	0.177

2.2 POST-DEVELOPMENT CONDITIONS

It is proposed to develop the site by constructing 38 townhouse units within 3 blocks. It is proposed to service the site with a private storm sewer system, designed and constructed in accordance with the City of Burlington Standards.

Two catchment areas, Catchment 201 and 202, have been identified in the post-development condition. Catchment 201 represents the area of the proposed rooftop and asphalt areas which will be subject to stormwater management controls before ultimately discharging to the existing 1.8m X 1.2m concrete culvert. Catchment 202 represents the

area of the proposed rooftop and asphalt areas which will drain uncontrolled to the existing catchbasins within the right-of-way and discharge to the existing 1.8m X 1.2m concrete culvert. See Table 2.3 below and the Post-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.3- Post-Development Catchment Area				
Catchment ID	Description	Area (ha)	% Imp.	Runoff Coefficient
201	Controlled to culvert	0.33	74	0.75
202	Uncontrolled to culvert	0.13	76	0.77

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 135mmø orifice pipe between proposed MH4 and MH7. The orifice pipe will prevent the post development discharge rate from exceeding the 5-year pre-development discharge rate in all storm events up to and including the 100-year event. See the Preliminary Site Servicing Plan for orifice location.

With the installation of on-site quantity control measures for Catchment 201, it will be required to provide stormwater storage during storm events up to and including the 100-year event. To provide the required storage, it is proposed to install Stormtech SC-740 underground storage tanks under the proposed asphalt laneway. The maximum tank volume has been proposed within the site, given the limited available space for stormwater storage.

Preliminary details of the proposed storage tanks can be found on the Preliminary Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.4 below and Appendix A for details.

Table 2.4 – Post-Development Condition Stage-Storage-Discharge (Catchment 201)		
Storm Event	Total Storage (m^3)	Discharge (m^3/s)
97.05 (Orifice Pipe)	0	0.0000
97.55 (Bottom of Tank)	0	0.0334
97.75 (0.20m Depth)	14	0.0403
97.95 (0.40m Depth)	28	0.0463
98.15 (0.60m Depth)	41	0.0515
98.31 (Top of Tank)	52	0.0554

An analysis was performed on Catchment 201 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington Design Storms. A summary of the results can be found in Table 2.5 below and the detailed SWMHYMO input/output information in Appendix B.

Table 2.5 – Post-Development Condition Site Discharge					
Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge* (m^3/s)	Required Storage (m^3)
2-Yr	0.039	0.024	0.062	0.108	10.9
5-Yr	0.043	0.031	0.074	0.108	20.0
10-Yr	0.046	0.036	0.081	0.108	26.6
25-Yr	0.049	0.042	0.090	0.108	34.5
50-Yr	0.051	0.047	0.097	0.108	40.6
100-Yr	0.053	0.051	0.103	0.108	46.6

* Allowable discharge equal to the 5-yr pre-development discharge

This analysis determined the following:

- The post-development discharge rated will not exceed the 5-year pre-development discharge rate during all storm events up to and including the 100-year storm, with the installation of an orifice pipe between MH4 and MH7;

- 46.6m^3 of stormwater storage is required during the 100-year event, which can be accommodated by the proposed storage vault, having a volume of 52m^3.

Water Quality Control

The proposed development is required to achieve an "Enhanced" (80% TSS removal) level of water quality protection. To achieve this criteria, discharge from Catchment 201 will be subject to treatment from a Hydroguard oil/grit separator before ultimately discharging to the existing 1.8m X 1.2m concrete culvert on Plains Road East. The Hydroguard sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a Hydroguard HG4i unit will be installed at CB7.1 and CBMH8 before discharging into the proposed storage tanks. At CB7.1 the HG unit will provide 97% TSS removal and 99% average annual runoff treatment and the HG unit at CBMH8 will provide 96% TSS removal and 99% average annual runoff treatment, which satisfies the requirements for an "Enhanced" level for quality control. See Hydroguard unit sizing procedures in Appendix C for details.

2.3 SEDIMENT AND EROSION CONTROL

In order to minimize erosion during the grading and site servicing period of construction, the following measures will be implemented:

- Install silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;

- Install sediment control (silt sacks) in the proposed catchbasins as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system;

- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion;
- Install a mud mat at the construction entrance of the site to reduce mud tracking and sediment leave the site via construction traffic;

To ensure and document the effectiveness of the erosion and sediment control structures, an appropriate inspection and maintenance program is necessary. The program will include the following activities:

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and

- The developer and/or his contractor shall be responsible for any costs incurred during the remediation of problem areas;

Details of the proposed erosion & sediment control measures will be provided on the Erosion and Sediment Control Plans, which will be provided upon final design.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

There are two existing sanitary mains which are located adjacent to the subject site. There is an existing 200mmø sanitary sewer along Helena Street and an existing 250mmø sanitary sewer along Plains Road. There are a series of existing sanitary laterals, which are currently servicing the existing buildings on-site. These lateral connect into the existing 250mmø sanitary sewer along Plains Road

3.2 SANITARY DEMAND

Sanitary discharge from the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual. Table 3.1 summarizes the sanitary sewer discharge rate for the subject lands.

Table 3.1- Post-Development Sanitary Sewer Discharge

Population [A*]	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
156 persons	0.497	4.19	0.132	**2.21**

[A] Population = (24 x 2 bdr units x 2 cap/bdr) + (10 x 3 bdr units x 2 cap/bdr) = 156 persons
[B] Average demand = 275 l/cap/day x population
[C] Peaking Factor = $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Site Area (0.46 hectares)
[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration
* Population is to be confirmed during site plan approval

3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed site will be serviced by a private 200mmø sanitary sewer, designed and constructed in accordance with the Region of Halton standards. Drainage from this sewer will discharge to the existing 250mmø sanitary sewer along Plains Road. Units fronting Plains Road and Helena Street are to connect directly into the sanitary sewers along these streets.

The minimum grade of the proposed 200mmø sanitary will be 0.5%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.023 m^3/s (23 l/s). Therefore, the proposed 200mmø sanitary sewer at 0.5% grade is adequately sized to service the proposed development.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of 150mmø watermains located along Helena Street and Plains Road. The nearest existing fire hydrant is located in front of the subject lands, at 1349 Plains Road East.

4.2 DOMESTIC WATER DEMAND

Water demand for the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual (Ref. 3). Tables 4.1 summarizes the domestic water demand requirements for the Average Daily, Maximum Daily and Peaking Hourly demand scenarios.

Table 4.1 - Post-Development Domestic Water Demand

Population [A*]	Average Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	**Max. Daily Demand [E] (l/s)**	**Max. Hourly Demand [F] (l/s)**
156 persons	0.497	2.25	4.00	**1.12**	**1.99**

[A] Population = (24 x 2 bdr units x 2 cap/bdr) + (10 x 3 bdr units x 2 cap/bdr) = 156 persons
[B] Average Daily Demand = 275 l/cap/day x population
[C] Max. Daily Peaking Factor = 2.25 (refer to sentence 2.4.1 in Ref.3)
[D] Max. Hourly Peaking Factor = 4.00 (refer to Table 2-2 in Ref. 3)
[E] Max. Daily Demand = Average Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Average Daily Demand x Max. Hourly Peaking Factor
* Population is to be confirmed during site plan approval

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA).

The proposed development consists of constructing 3 3-storey residential townhouse blocks with associated asphalt driveway/parking lot, concrete curbing and landscaped areas. An additional private fire hydrant is proposed to meet the required 90m separation to the building face of the proposed townhouse blocks (as per Sentence 3.2.5.7 of the 2012 Ontario Building Code).

The townhouse blocks will be constructed with ordinary construction buildings (C=1.0) and with limited combustible occupancy (-15% correction). It was determined that Block 2 will require the greatest fire flow. Exposure corrections for Block 2 are based on the following:

North Face: 15% correction (10.1m to 20m)
South Face: 0% correction (>45m)
East Face: 15% correction (10.1m to 20m)
West Face: 10% correction (20.1m to 30m)
Total: 45%

It is estimated that the required fire flow for the proposed townhouse development will be **150 l/s** (Block 1), **233 l/s** (Block 2) and **200 l/s** (Block 3). Hydrant flow tests will be scheduled to determine the maximum available flow rate along Plains Road and Helena Street. The hydrant flow test results will be provided once they are available. See Fire Flow Demand Requirements in Appendix D for calculations and details for all Blocks.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

The proposed water servicing for the subject site consists of installing a 150mmø watermain that will connect into the existing 150mmø watermain along Plains Road. Units fronting Plains Road and Helena Street are to be directly connected to the existing watermains along these streets. Water services for the site are to be designed and constructed in accordance with the Halton Region standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 1335-1355 Plains Road East can be constructed to meet the requirements of the City of Burlington and Halton Region. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Preliminary Grading Plan and the Preliminary Site Servicing Plan prepared by S.Llewellyn & Associates Limited;

- A 135mmø orifice pipe be installed as per the Preliminary Site Servicing Plan and this report to provide adequate quantity control;

- An underground storage tanks be incorporated under the proposed asphalt laneway as per the Preliminary Site Servicing Plan to provide stormwater storage;

- A Hydroguard HG4i oil/grit separators be installed as per the Preliminary Site Servicing Plan and this report to provide efficient stormwater quality control;

- Erosion and sediment controls be installed as described in this report to meet City of Burlington requirements;

- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development;

- This report be used as the basis for the servicing and stormwater management design. All design data, assumptions and calculations will be confirmed and/or updated as part of the future Site Plan Approval submission;

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED



M. Colosimo, Dipl.T

S. Frankovich, P.Eng.

APPENDIX A
STORMWATER MANAGEMENT INFORMATION

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SUBJECT TO AN EASEMENT as in instrument no. hr31597

EX. STM CBMH (NOT SURVEYED) N.INV. ±97.16 E.INV. ±97.09 W.INV. ±97.22

EX. STM CBMH (NOT SURVEYED) N.INV. ±97.13 W.INV. ±97.06 S.INV. ±96.98

EX. 1 STOREY BRICK DWELLING No. 1024

EX. BOARD FENCE

EX. EDGE OF ASPHALT

EX. EDGE OF ROAD

EX. GAZEBO

EX. SHED (TO BE REMOVED)

EX. METAL POST

EX. ASPHALT DRIVEWAY

EX. STEPS

EX. COVERED PORCH

EX. CHAIN LINK FENCE

EX. ASPHALT (TO BE REMOVED)

EX. PLAYGROUND (TO BE REMOVED)

EX. 2-STOREY BUILDING No. 1335 (TO BE REMOVED)

EX. RUBBER PAD (TO BE REMOVED)

EX. GRASS

EX. CURB (TO BE REMOVED)

EX. BOARD FENCE (TO BE REMOVED)

EX. MONITORING WELL

EX. OVERHEAD WIRE (TO BE REMOVED)

EX. 1.5 STOREY DWELLING No. 1343 (TO BE REMOVED)

EX. 1-STOREY BUILDING No. 1349 (TO BE REMOVED)

EX. 1-STOREY BUILDING No. 1355 (TO BE REMOVED)

EX. ASPHALT PARKING (TO BE REMOVED)

EX. CONCRETE PAD

EX. BOLLARD

EX. CONCRETE WALKWAY

EX. SIDEWALK

EX. CURB CUT

EX. CURB

EX. GUTTER

EX. CENTRELINE OF ROAD

EX. CB T/G 99.29

EX. CB T/G 99.17

EX. CB T/G 98.84

EX. STM MH T/G 98.66

EX. DCB T/G 98.60

EX. SAN MH T/G 98.97 N.INV. 96.08 E.INV. 96.26 W.INV. 96.04

EX. SAN MH T/G 98.49 N.INV. 95.55 W.INV. 95.53

EX. SAN MH T/G 99.08 E.INV. 95.74 S.INV. 95.72

EX. ASPHALT PARKING LOT

EX. TOP OF SLOPE

EX. BUSH

EX. SIGN

EX. HYD.

EX. UP

EX. GV

EX. CABLE BOX

EX. BELL BOX

EX. OVERHEAD WIRE

EX. W

EX. 2xHV

EX. 2x0.15ø CON.

EX. 0.35ø DEC.

EX. 0.30ø DEC.

EX. 0.20ø DEC.

EX. 0.45ø CON.

EX. 0.40ø CON.

EX. 0.60ø DEC.

EX. 0.30ø CON.

EX. 1.20ø DEC.

EX. 3x0.20ø CON.

EX. 0.50ø DEC.

EX. 0.15ø CON.

EX. WOOD WALKWAY

EX. COVERED PORCH

EX. SHED (TO BE REMOVED)

EX. SANDBOX (TO BE REMOVED)

EX. COVERED PORCH

EX. FRAME SHED

EX. MONITORING WELL

EX. RUBBER PAD (TO BE REMOVED)

EX. BOARD FENCE (TO BE REMOVED)

EX. CURB (TO BE REMOVED)

EX. GRASS

EX. BOARD FENCE

EX. CURB CUT

EX. BOLLARD

EX. SIDEWALK

EX. BRICK SIDEWALK

EX. CURB CUT

EX. CURB

EX. GUTTER

EX. CENTRELINE OF ROAD

EX. OVERHEAD WIRE

EX. SIGN

EX. UP

EX. GV

EX. CABLE BOX

EX. BELL BOX

EX. 2xHV

EX. SAN MH T/G 98.97 N.INV. 96.08 E.INV. 96.26 W.INV. 96.04

EX. STM MH T/G 98.89

EX. CB T/G 98.84

EX. DCB T/G 98.60

EX. STM MH T/G 98.66

EX. SAN MH T/G 98.49 N.INV. 95.55 W.INV. 95.53

EX. SAN MH T/G 99.08 E.INV. 95.74 S.INV. 95.72

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EX. 0.20ø DEC.

EX. 0.45ø CON.

EX. 0.40ø CON.

EX. 0.60ø DEC.

EX. 0.30ø CON.

EX. 1.20ø DEC.

EX. 3x0.20ø CON.

EX. 0.50ø DEC.

EX. 0.15ø CON.

101
0.46
81
0.79

HELENA ST

GLENDOR AVE

PLAINS RD E

LEGEND

PERVIOUS AREA

101
0.39
11
0.32

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

FIGURE 1.0
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 1335-1349 PLAINS ROAD EAST
PROJECT No.: 17112

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SUBJECT TO AN EASEMENT as in instrument no. hr31597

43.0m SWALE @ 1.5%

CB9.1 T/G 98.45

EX. STM CBMH (NOT SURVEYED) N.INV. ±97.16 E.INV. ±97.09 W.INV. ±97.22

EX. STM CBMH (NOT SURVEYED) N.INV. ±97.13 E.INV. ±97.06 S.INV. ±96.98

EX. BOARD FENCE

EX. 1 STOREY BRICK DWELLING No. 1024

13.0m SWALE @ 1.5%

12.5m SWALE @ 2.0%

EX. WOOD WALL

EX. CABLE BOX/ BELL BOX

EX. UP

EX. STM MH T/G 98.90

EX. SAN MH T/G 98.69 N.INV. 96.36 S.INV. 96.34

EX. CURB

EX. SIDEWALK

EX. CURB CUT

EX. GUTTER

EX. CENTRELINE OF ROAD

HELENA ST

EX. BOARD FENCE

EX. CHAIN LINK FENCE

EX. CB T/G 99.17

MH6

16.0m–450mmø STM @ 0.40%

MH5

22.5m–450mmø STM @ 0.40%

EX. STM DMH (NOT SURVEYED) N.INV. ±96.92 W.INV. ±96.74 S.INV. ±96.69

1.0m–600mmø STM @ 5.0%

20.5m–450mmø STM @ 0.40%

EX. CB T/G 99.2

EX. CB & LEAD (TO BE REMOVED)

5.5m–250mmø STM @ 0.4%

CB7.1 T/G 98.90

MH7

MH4

2.0m–135mmø STM @ 2.5% (ORIFICE PIPE)

CBMH8 T/G 98.90

15.5m–525mmø STM @ 0.40%

PROP. SEWER INSULATION (WHERE SEWER HAS LESS THAN 1.2m COVER) (AS PER DETAIL)

STORAGE TANK STORMTECH SC-740 (c/w INSPECTION PORTS & ISOLATOR ROWS @ INLETS) TANK VOLUME = 52m³ TOP OF TANK = 98.31 BOTTOM OF TANK = 97.55 (CONTRACTOR TO PROVIDE SHOP DWG'S)

6.5m–300mmø STM @ 0.4%

14.5m–250mmø STM @ 0.4%

MH3

10.0m–525mmø STM @ 0.40%

CB8.1 T/G 98.85

MH2

14.0m–525mmø STM @ 0.40%

EX. SIDEWALK

EX. GV

EX. WV

EX. SAN MH T/G 99.08 E.INV. 95.74 S.INV. 95.72

EX. UP

OVERHEAD WIRE

EX. SIDEWALK

EX. CURB

EX. CURB CUT

EX. DCB T/G 98.60

EX. STM MH T/G 98.66

EX. SAN MH T/G 98.49 N.INV. 95.55 W.INV. 95.53

EX. CENTRELINE OF ROAD

GLENDOR AVE

EX. GUTTER

EX. HYD

PLAINS RD E

EX. SAN MH T/G 98.97 N.INV. 96.08 E.INV. 96.26 W.INV. 96.04

EX. SIGN

EX. STM MH T/G 98.89

EX. CB T/G 98.84

201
0.33
74
0.75

202
0.13
76
0.77

LEGEND

PERVIOUS AREA

201
0.39
11
0.32

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

FIGURE 1.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 1335-1349 PLAINS ROAD EAST
PROJECT No.: 17112

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Plains Road
Burlington, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Circular Orifice
Diameter (mm)	**135**
Area (m^2)	0.01431
Invert Elev. (m)	97.05
C/L Elev. (m)	97.12
Disch. Coeff. (C_d)	0.8
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes						Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Additional Incremental Underground	Additional Incremental Surface m^3	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	97.05	0	0	0.0	0	0	0	0.000	0.0000
Bottom of Tank	97.55	69	0	0.0	0	0	0	0.433	0.0334
0.20m Deep	97.75	69	14	0.0	0	14	14	0.633	0.0403
0.40m Deep	97.95	69	14	0.0	0	28	28	0.833	0.0463
0.60m Deep	98.15	69	14	0.0	0	41	41	1.033	0.0515
Top of Tank	98.31	69	11	0.0	0	52	52	1.193	0.0554

User Inputs

Chamber Model	SC-740
Outlet Control Structure	Yes (Outlet)
Project Name	1331-1355 Plains Road East
Engineer	Michael
Project Location	Burlington Ontario
Project Date	12/11/2017
Measurement Type	Metric
Required Storage Volume	50 cubic meters
Stone Porosity	40%
Stone Foundation Depth	152 mm.
Stone Above Chambers	152 mm.
Average Cover Over Chambers	460 mm.
Design Constraint	Width
Design Constraint Dimension	3 meters

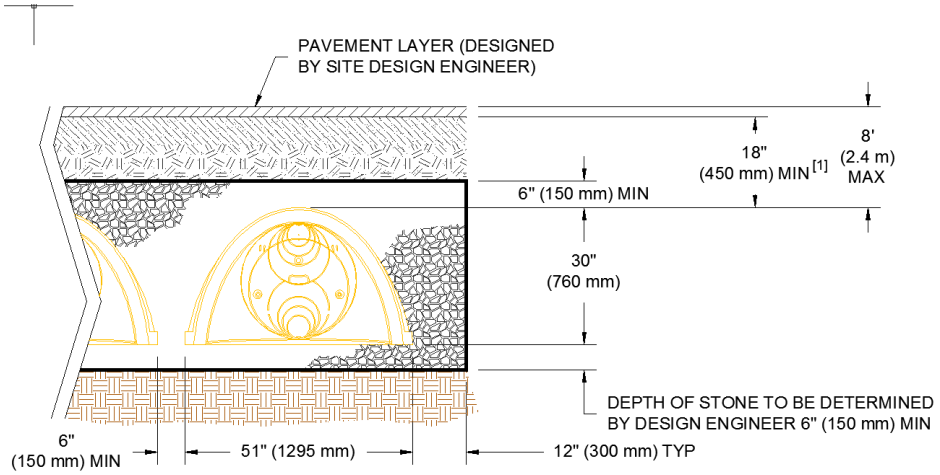
Results

System Volume and Bed Size

Installed Storage Volume	52 cubic meters
Storage Volume Per Chamber	2.12 cubic meters
Number Of Chambers Required	18 each
Number Of End Caps Required	2 each
Rows/Chambers	1 row(s) of 18 chamber(s)
Maximum Length	42.43 meters
Maximum Width	2.09 meters
Approx. Bed Size Required	89 square meters

System Components

Amount Of Stone Required	71 cubic meters
Volume Of Excavation (Not Including Fill)	94 cubic meters
Non-woven Filter Fabric Required	267 square meters
Length Of Isolator Row	39.54 meters
Non-Woven Isolator Row Fabric	94 square meters
Woven Isolator Row Fabric	117 square meters



[1] - TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

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APPENDIX B
SWMHYMO INPUT/OUTPUT INFORMATION

```
2     Metric units
*#*************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#*************************************************************************|
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BURL_002.stm
*
READ STORM          STORM_FILENAME "STORM.001"
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.46](ha),
                    XIMP=[0.81], TIMP=[0.81], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[1.0](%),
                                         LGP=[10](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.2](%),
                                         LGI=[15](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
**#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1](min), AREA=[0.33](ha),
                    XIMP=[0.74], TIMP=[0.74], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[2.0](%),
                                         LGP=[8.0](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.5](%),
                                         LGI=[15](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-------------------------------------------------------|
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
ROUTE RESERVOIR     IDout=[2],   NHYD=["201"],  IDin=[1],
                    RDT=[    ](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                   (cms) - (ha-m)
                                    0.0    , 0.0
                                    0.0334 , 0.0000
                                    0.0403 , 0.0014
                                    0.0463 , 0.0028
                                    0.0515 , 0.0041
                                    0.0554 , 0.0052
                                    -1  ,  -1    (max twenty pts)
```

```
                          IDovf=[3], NHYDovf=["OVF"]
*%-----------------|-------------------------------------------------------|
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
CALIB STANDHYD      ID=[4], NHYD=["202"], DT=[1](min), AREA=[0.13](ha),
                    XIMP=[0.76], TIMP=[0.76], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[98],
                    Pervious   surfaces: IAper=[0.52](mm), SLPP=[4.0](%),
                                         LGP=[6.0](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[4.5](%),
                                         LGI=[6.0](m), MNI=[0.013], SCI=[0](min)
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|-------------------------------------------------------|
ADD HYD             IDsum=[5], NHYD=["201+202"], IDs to add=[2, 3, 4]
*%-----------------|-------------------------------------------------------|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    BURL_005.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
                    BURL_010.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    BURL_025.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    BURL_050.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    BURL_100.stm
*
*%-----------------|-------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO            9      9   =========
                                                          9   9  9   9   # 3902680
        StormWater Management HYdrologic Model            999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: S. Llewellyn & Associates Ltd                +++++++++
 +++++++++                Burlington           SERIAL#:3902680        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********          ++++++ PROGRAM ARRAY DIMENSIONS ++++++             *********
 *********          Maximum value for ID numbers  :     10            *********
 *********          Max. number of rainfall points: 105408            *********
 *********          Max. number of flow points    : 105408            *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2017-12-14     TIME: 17:06:53     RUN COUNTER: 000719          *
 ********************************************************************************
 * Input   filename: T:\projects\17112\FSR\SWMHYMO\17112.dat                     *
 * Output  filename: T:\projects\17112\FSR\SWMHYMO\17112.out                     *
 * Summary filename: T:\projects\17112\FSR\SWMHYMO\17112.sum                     *
 * User comments:                                                               *
 * 1:_____________________________________________________________________________*
 * 2:_____________________________________________________________________________*
 * 3:_____________________________________________________________________________*
 ********************************************************************************

--------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
          #  1=BURL_002.stm
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 2-YR BURLINGTON CHICAGO STORM (4-HR DURA
| Ptotal=  32.34 mm|    Comments: 2-YR BURLINGTON CHICAGO STORM (4-HR DURA
--------------------
            TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
             hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
             .17   2.193 |   1.17  17.083 |   2.17   5.221 |   3.17   2.635
             .33   2.511 |   1.33  68.163 |   2.33   4.444 |   3.33   2.448
             .50   2.955 |   1.50  22.413 |   2.50   3.884 |   3.50   2.289
             .67   3.627 |   1.67  11.979 |   2.67   3.459 |   3.67   2.151
             .83   4.775 |   1.83   8.270 |   2.83   3.126 |   3.83   2.031
            1.00   7.239 |   2.00   6.374 |   3.00   2.857 |   4.00   1.925


--------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#                                                                             *
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING                       *
*#        ==============================================                       *
*#                                                                             *
**#*****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .37          .09
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.20         1.00
     Length            (m)=      15.00        10.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      68.16        63.45
                   over (min)       1.00         5.00
     Storage Coeff.  (min)=        .90 (ii)    5.44 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.14          .21
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .07          .01          .082 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=      31.34        27.36        30.586
     TOTAL RAINFALL   (mm)=      32.34        32.34        32.342
     RUNOFF COEFFICIENT   =        .97          .85          .946

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------
**#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .24          .09
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.50         2.00
     Length            (m)=      15.00         8.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      68.16        63.74
                   over (min)       1.00         4.00
     Storage Coeff.  (min)=        .72 (ii)    3.94 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.27          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .05          .01          .059 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=      31.34        27.36        30.308
     TOTAL RAINFALL   (mm)=      32.34        32.34        32.342
     RUNOFF COEFFICIENT   =        .97          .85          .937

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00   |     .046  .2800E-02
                             .033  .0000E+00   |     .052  .4100E-02
                             .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .059     1.333     30.308
     OUTFLOW<02: (201   )        .33      .039     1.350     30.376
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   65.118
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1088E-02

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .03
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       4.50         4.00
     Length            (m)=       6.00         6.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=      68.16        64.00
                   over (min)       1.00         3.00
     Storage Coeff.  (min)=        .35 (ii)    2.55 (ii)
     Unit Hyd. Tpeak (min)=       1.00         3.00
     Unit Hyd. peak  (cms)=       1.60          .42
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .02          .01          .024 (iii)
     TIME TO PEAK    (hrs)=       1.25         1.33         1.333
     RUNOFF VOLUME    (mm)=      31.34        27.36        30.388
     TOTAL RAINFALL   (mm)=      32.34        32.34        32.342
     RUNOFF COEFFICIENT   =        .97          .85          .940

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```

```
         CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------
----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .33     .039    1.35  30.38    .000
                     +ID2 03:OVF            .00     .000     .00    .00    .000
                     +ID3 04:202            .13     .024    1.33  30.39    .000
                      ========================================================
                      SUM 05:201+202        .46     .062    1.33  30.38    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
  ** END OF RUN :   4

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=BURL_005.stm
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#*****************************************************************************|
*
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 5-YR BURLINGTON CHICAGO STORM (4-HR DURA
| Ptotal=  41.70 mm|    Comments: 5-YR BURLINGTON CHICAGO STORM (4-HR DURA
--------------------
            TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
             hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
             .17   2.963 |   1.17  21.285 |   2.17   6.805 |   3.17   3.535
             .33   3.374 |   1.33  88.094 |   2.33   5.834 |   3.33   3.293
             .50   3.946 |   1.50  27.774 |   2.50   5.128 |   3.50   3.087
             .67   4.803 |   1.67  15.072 |   2.67   4.590 |   3.67   2.908
             .83   6.247 |   1.83  10.561 |   2.83   4.165 |   3.83   2.751
            1.00   9.295 |   2.00   8.234 |   3.00   3.820 |   4.00   2.612

------------------------------------------------------------------------------
005:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*****************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .37          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.20         1.00
     Length            (m)=     15.00        10.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.00
                  over (min)       1.00         5.00
     Storage Coeff.  (min)=       .82 (ii)    4.87 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.20          .23
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .09          .02          .108 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        39.912
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .957

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
005:0004----------------------------------------------------------------------
**#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*****************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .24          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.50         2.00
     Length            (m)=     15.00         8.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.27
                  over (min)       1.00         4.00
     Storage Coeff.  (min)=       .65 (ii)    3.53 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.33          .31
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .06          .02          .078 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        39.624
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .950

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
005:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .046  .2800E-02
                            .033  .0000E+00   |     .052  .4100E-02
                            .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .078     1.333     39.624
     OUTFLOW<02: (201   )        .33      .043     1.350     39.717
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   54.986
                   TIME SHIFT OF PEAK FLOW         (min)=     1.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1995E-02

------------------------------------------------------------------------------
005:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .10          .03
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      4.50         4.00
     Length            (m)=      6.00         6.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     88.09        84.72
                  over (min)       1.00         2.00
     Storage Coeff.  (min)=       .32 (ii)    2.28 (ii)
     Unit Hyd. Tpeak (min)=      1.00         2.00
     Unit Hyd. peak  (cms)=      1.63          .51
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .02          .01          .031 (iii)
     TIME TO PEAK    (hrs)=      1.25         1.33         1.333
     RUNOFF VOLUME    (mm)=     40.70        36.57        39.706
     TOTAL RAINFALL   (mm)=     41.70        41.70        41.696
     RUNOFF COEFFICIENT   =       .98          .88          .952

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
005:0007----------------------------------------------------------------------
----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .33     .043    1.35  39.72    .000
                     +ID2 03:OVF            .00     .000     .00    .00    .000
                     +ID3 04:202            .13     .031    1.33  39.71    .000
                      ========================================================
                      SUM 05:201+202        .46     .074    1.33  39.71    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
005:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
  ** END OF RUN :   9

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
```

```
    NRUN  = 010
    NSTORM=   1
          #  1=BURL_010.stm
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*#**************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#**************************************************************************|
*
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 10-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  48.00 mm|    Comments: 10-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.423 |   1.17  24.501 |   2.17   7.852 |   3.17   4.083
               .33   3.898 |   1.33 101.139 |   2.33   6.733 |   3.33   3.805
               .50   4.558 |   1.50  31.955 |   2.50   5.920 |   3.50   3.567
               .67   5.545 |   1.67  17.363 |   2.67   5.300 |   3.67   3.360
               .83   7.210 |   1.83  12.175 |   2.83   4.810 |   3.83   3.179
              1.00  10.719 |   2.00   9.497 |   3.00   4.413 |   4.00   3.019


------------------------------------------------------------------------------
010:0003----------------------------------------------------------------------
*
*#**************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .37          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.20         1.00
     Length            (m)=     15.00        10.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    101.14        97.40
               over (min)       1.00         5.00
     Storage Coeff.  (min)=       .77 (ii)    4.59 (ii)
     Unit Hyd. Tpeak (min)=      1.00         5.00
     Unit Hyd. peak  (cms)=      1.23          .24
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .10          .02          .124 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=     47.00        42.81        46.207
     TOTAL RAINFALL   (mm)=     48.00        48.00        48.004
     RUNOFF COEFFICIENT   =       .98          .89          .963

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.


------------------------------------------------------------------------------
010:0004----------------------------------------------------------------------
**#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .24          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.50         2.00
     Length            (m)=     15.00         8.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    101.14        97.88
               over (min)       1.00         3.00
     Storage Coeff.  (min)=       .62 (ii)    3.33 (ii)
     Unit Hyd. Tpeak (min)=      1.00         3.00
     Unit Hyd. peak  (cms)=      1.36          .35
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .07          .02          .090 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     47.00        42.81        45.914
     TOTAL RAINFALL   (mm)=     48.00        48.00        48.004
     RUNOFF COEFFICIENT   =       .98          .89          .956

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.


------------------------------------------------------------------------------
010:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                        .000  .0000E+00   |     .046  .2800E-02
                        .033  .0000E+00   |     .052  .4100E-02
                        .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .090     1.333     45.914
     OUTFLOW<02: (201   )        .33      .046     1.367     46.034
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   50.575
                    TIME SHIFT OF PEAK FLOW         (min)=     2.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2660E-02

------------------------------------------------------------------------------
010:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .10          .03
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      4.50         4.00
     Length            (m)=      6.00         6.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    101.14        98.07
               over (min)       1.00         2.00
     Storage Coeff.  (min)=       .30 (ii)    2.15 (ii)
     Unit Hyd. Tpeak (min)=      1.00         2.00
     Unit Hyd. peak  (cms)=      1.64          .53
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .03          .01          .036 (iii)
     TIME TO PEAK    (hrs)=      1.25         1.33         1.333
     RUNOFF VOLUME    (mm)=     47.00        42.81        45.997
     TOTAL RAINFALL   (mm)=     48.00        48.00        48.004
     RUNOFF COEFFICIENT   =       .98          .89          .958

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
010:0007----------------------------------------------------------------------
----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201          .33     .046    1.37  46.03    .000
                       +ID2 03:OVF          .00     .000     .00    .00    .000
                       +ID3 04:202          .13     .036    1.33  46.00    .000
                        ==========================================================
                        SUM 05:201+202      .46     .081    1.33  46.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
010:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
  ** END OF RUN :  24

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
          #  1=BURL_025.stm
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*#**************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#**************************************************************************|
*
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 25-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  56.03 mm|    Comments: 25-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.010 |   1.17  28.592 |   2.17   9.185 |   3.17   4.782
               .33   4.566 |   1.33 117.720 |   2.33   7.879 |   3.33   4.457
               .50   5.337 |   1.50  37.274 |   2.50   6.929 |   3.50   4.178
               .67   6.491 |   1.67  20.279 |   2.67   6.204 |   3.67   3.937
               .83   8.435 |   1.83  14.230 |   2.83   5.632 |   3.83   3.725
              1.00  12.531 |   2.00  11.105 |   3.00   5.167 |   4.00   3.538

------------------------------------------------------------------------------
```

```
025:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .37          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.20         1.00
     Length            (m)=     15.00        10.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       114.59
               over (min)        1.00         4.00
     Storage Coeff.  (min)=       .73 (ii)    4.31 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.27          .27
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .12          .02          .146 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.221
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .968

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
025:0004----------------------------------------------------------------------
**#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .24          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      2.50         2.00
     Length            (m)=     15.00         8.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       114.79
               over (min)        1.00         3.00
     Storage Coeff.  (min)=       .58 (ii)    3.13 (ii)
     Unit Hyd. Tpeak (min)=      1.00         3.00
     Unit Hyd. peak  (cms)=      1.39          .37
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .08          .03          .106 (iii)
     TIME TO PEAK    (hrs)=      1.32         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        53.923
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .962

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
025:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .046  .2800E-02
                            .033  .0000E+00   |     .052  .4100E-02
                            .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .106     1.333     53.923
     OUTFLOW<02: (201   )        .33      .049     1.367     53.947
    OVERFLOW<03: (OVF   )        .00      .000      .000      .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   46.324
                   TIME SHIFT OF PEAK FLOW       (min)=     2.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3459E-02

-------------------------------------------------------------------------------
025:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .10          .03
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      4.50         4.00
     Length            (m)=      6.00         6.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=    117.72       114.97
               over (min)        1.00         2.00
     Storage Coeff.  (min)=       .28 (ii)    2.02 (ii)
     Unit Hyd. Tpeak (min)=      1.00         2.00
     Unit Hyd. peak  (cms)=      1.65          .56
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .03          .01          .042 (iii)
     TIME TO PEAK    (hrs)=      1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=     55.03        50.77        54.008
     TOTAL RAINFALL   (mm)=     56.03        56.03        56.030
     RUNOFF COEFFICIENT   =       .98          .91          .964

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
025:0007----------------------------------------------------------------------
-----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .33     .049    1.37  53.95    .000
                     +ID2 03:OVF            .00     .000     .00    .00    .000
                     +ID3 04:202            .13     .042    1.33  54.01    .000
                      ==========================================================
                      SUM 05:201+202        .46     .090    1.33  53.96    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
025:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
-------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
-------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
-------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
  ** END OF RUN :  49

********************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
          #  1=BURL_050.stm
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#*************************************************************************|
*
-------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 50-YR BURLINGTON CHICAGO STORM (4-HR DUR
| Ptotal=  61.96 mm|    Comments: 50-YR BURLINGTON CHICAGO STORM (4-HR DUR
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   4.451 |   1.17  31.613 |   2.17  10.180 |   3.17   5.306
              .33   5.067 |   1.33 129.819 |   2.33   8.734 |   3.33   4.946
              .50   5.921 |   1.50  41.194 |   2.50   7.683 |   3.50   4.637
              .67   7.198 |   1.67  22.439 |   2.67   6.881 |   3.67   4.369
              .83   9.350 |   1.83  15.757 |   2.83   6.247 |   3.83   4.135
             1.00  13.879 |   2.00  12.303 |   3.00   5.733 |   4.00   3.927

-------------------------------------------------------------------------------
050:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#*************************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .37          .09
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      1.20         1.00
     Length            (m)=     15.00        10.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    129.82       126.91
               over (min)        1.00         4.00
     Storage Coeff.  (min)=       .70 (ii)    4.14 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.29          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .13          .03          .161 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
```

```
     RUNOFF VOLUME    (mm)=      60.96        56.66        60.145
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .971

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0004----------------------------------------------------------------------
**#************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#************************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .24          .09
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.50         2.00
     Length            (m)=      15.00         8.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.10
               over (min)        1.00         3.00
     Storage Coeff.  (min)=        .56 (ii)    3.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         3.00
     Unit Hyd. peak  (cms)=       1.41          .38
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .09          .03          .117 (iii)
     TIME TO PEAK    (hrs)=       1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.66        59.844
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .966

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .046  .2800E-02
                            .033  .0000E+00   |     .052  .4100E-02
                            .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .117     1.333     59.844
     OUTFLOW<02: (201   )        .33      .051     1.383     59.864
    OVERFLOW<03: (OVF   )        .00      .000      .000      .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   43.922
                    TIME SHIFT OF PEAK FLOW        (min)=     3.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4058E-02

------------------------------------------------------------------------------
050:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .03
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       4.50         4.00
     Length            (m)=       6.00         6.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     129.82       127.27
               over (min)        1.00         2.00
     Storage Coeff.  (min)=        .27 (ii)    1.94 (ii)
     Unit Hyd. Tpeak (min)=       1.00         2.00
     Unit Hyd. peak  (cms)=       1.66          .57
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .04          .01          .047 (iii)
     TIME TO PEAK    (hrs)=       1.25         1.33         1.333
     RUNOFF VOLUME    (mm)=      60.96        56.66        59.930
     TOTAL RAINFALL   (mm)=      61.96        61.96        61.962
     RUNOFF COEFFICIENT   =        .98          .91          .967

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0007----------------------------------------------------------------------
-----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .33      .051    1.38  59.86    .000
                     +ID2 03:OVF            .00      .000     .00    .00    .000
                     +ID3 04:202            .13      .047    1.33  59.93    .000
                      ========================================================
                      SUM 05:201+202        .46      .097    1.33  59.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
050:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
  ** END OF RUN :  99

************************************************************************




--------------------
| START            |  Project  dir.: T:\projects\17112\FSR\SWMHYMO\
--------------------  Rainfall dir.: T:\projects\17112\FSR\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
          #  1=BURL_100.stm
------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*#************************************************************************|
*#  Project Name: 1335-1355 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 17112
*#       Date   : DECEMBER 2017
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 17112.DAT
*#************************************************************************|
*
------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 100-YR BURLINGTON CHICAGO STORM (4-HR DU
| Ptotal=  67.72 mm|    Comments: 100-YR BURLINGTON CHICAGO STORM (4-HR DU
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   4.865 |   1.17  34.553 |   2.17  11.126 |   3.17   5.800
               .33   5.538 |   1.33 141.892 |   2.33   9.547 |   3.33   5.406
               .50   6.472 |   1.50  45.024 |   2.50   8.397 |   3.50   5.068
               .67   7.868 |   1.67  24.526 |   2.67   7.521 |   3.67   4.776
               .83  10.219 |   1.83  17.223 |   2.83   6.828 |   3.83   4.519
              1.00  15.170 |   2.00  13.447 |   3.00   6.266 |   4.00   4.292

------------------------------------------------------------------------------
100:0003----------------------------------------------------------------------
*
*#************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
**#***********************************************************************|
*# CATCHMENT 101 - Existing Condition (to Plains Road East)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .46
| 01:101    DT= 1.00 |   Total Imp(%)=   81.00   Dir. Conn.(%)=   81.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .37          .09
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       1.20         1.00
     Length            (m)=      15.00        10.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.17
               over (min)        1.00         4.00
     Storage Coeff.  (min)=        .67 (ii)    3.99 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.31          .28
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .15          .03          .177 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72        62.39        65.901
     TOTAL RAINFALL   (mm)=      67.72        67.72        67.724
     RUNOFF COEFFICIENT   =        .99          .92          .973

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0004----------------------------------------------------------------------
**#***********************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#***********************************************************************|
*# CATCHMENT 201 - Proposed Condition (Controlled to Plains Rd)
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .33
| 01:201    DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   74.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .24          .09
```

```
     Dep. Storage     (mm)=       1.00          .52
     Average Slope     (%)=       2.50         2.00
     Length            (m)=      15.00         8.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.35
               over (min)         1.00         3.00
     Storage Coeff.  (min)=        .54 (ii)    2.89 (ii)
     Unit Hyd. Tpeak (min)=       1.00         3.00
     Unit Hyd. peak  (cms)=       1.43          .38
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .10          .03          .128 (iii)
     TIME TO PEAK    (hrs)=       1.30         1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72        62.39        65.598
     TOTAL RAINFALL   (mm)=      67.72        67.72        67.724
     RUNOFF COEFFICIENT   =        .99          .92          .969

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
100:0005----------------------------------------------------------------------
*# ROUTE CATCHMENT 201 - THROUGH ORIFICE
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .046  .2800E-02
                           .033  .0000E+00   |     .052  .4100E-02
                           .040  .1400E-02   |     .055  .5200E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .33      .128     1.333     65.598
     OUTFLOW<02: (201   )        .33      .053     1.383     65.685
    OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   41.795
                    TIME SHIFT OF PEAK FLOW         (min)=     3.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4659E-02

--------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
*# CATCHMENT 202 - Proposed Condition (Uncontrolled to Plains Rd)
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .13
| 04:202    DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   76.00
---------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .10          .03
     Dep. Storage     (mm)=      1.00          .52
     Average Slope     (%)=      4.50         4.00
     Length            (m)=      6.00         6.00
     Mannings n            =      .013         .250

     Max.eff.Inten.(mm/hr)=     141.89       139.51
               over (min)         1.00         2.00
     Storage Coeff.  (min)=        .26 (ii)    1.87 (ii)
     Unit Hyd. Tpeak (min)=       1.00         2.00
     Unit Hyd. peak  (cms)=       1.66          .58
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .04          .01          .051 (iii)
     TIME TO PEAK    (hrs)=       1.25         1.33         1.333
     RUNOFF VOLUME    (mm)=      66.72        62.39        65.684
     TOTAL RAINFALL   (mm)=      67.72        67.72        67.724
     RUNOFF COEFFICIENT   =        .99          .92          .970

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

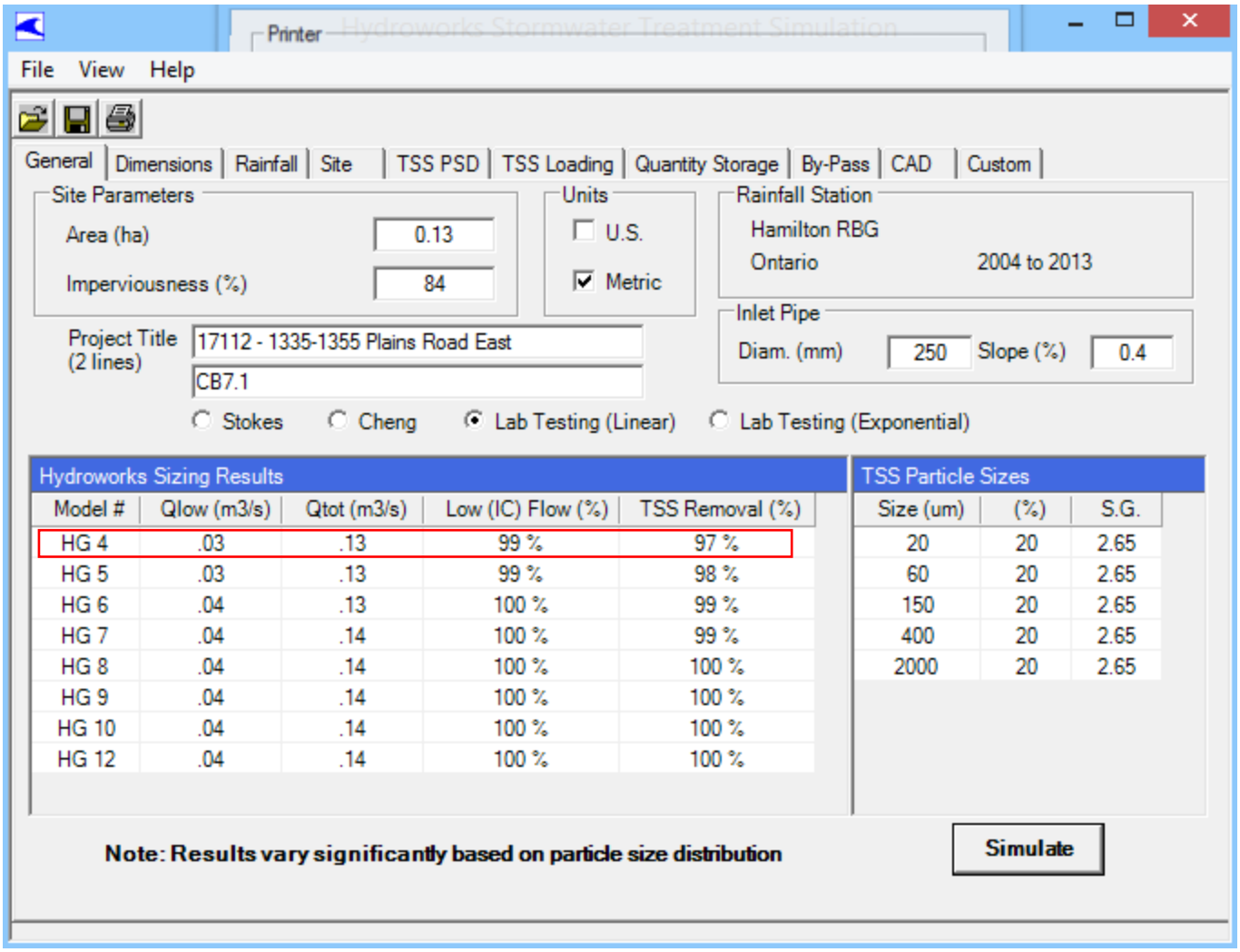
--------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
----------------------
| ADD HYD (201+202   ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201            .33      .053    1.38  65.68    .000
                     +ID2 03:OVF            .00      .000     .00    .00    .000
                     +ID3 04:202            .13      .051    1.33  65.68    .000
                      ==========================================================
                      SUM 05:201+202        .46      .103    1.33  65.68    .000

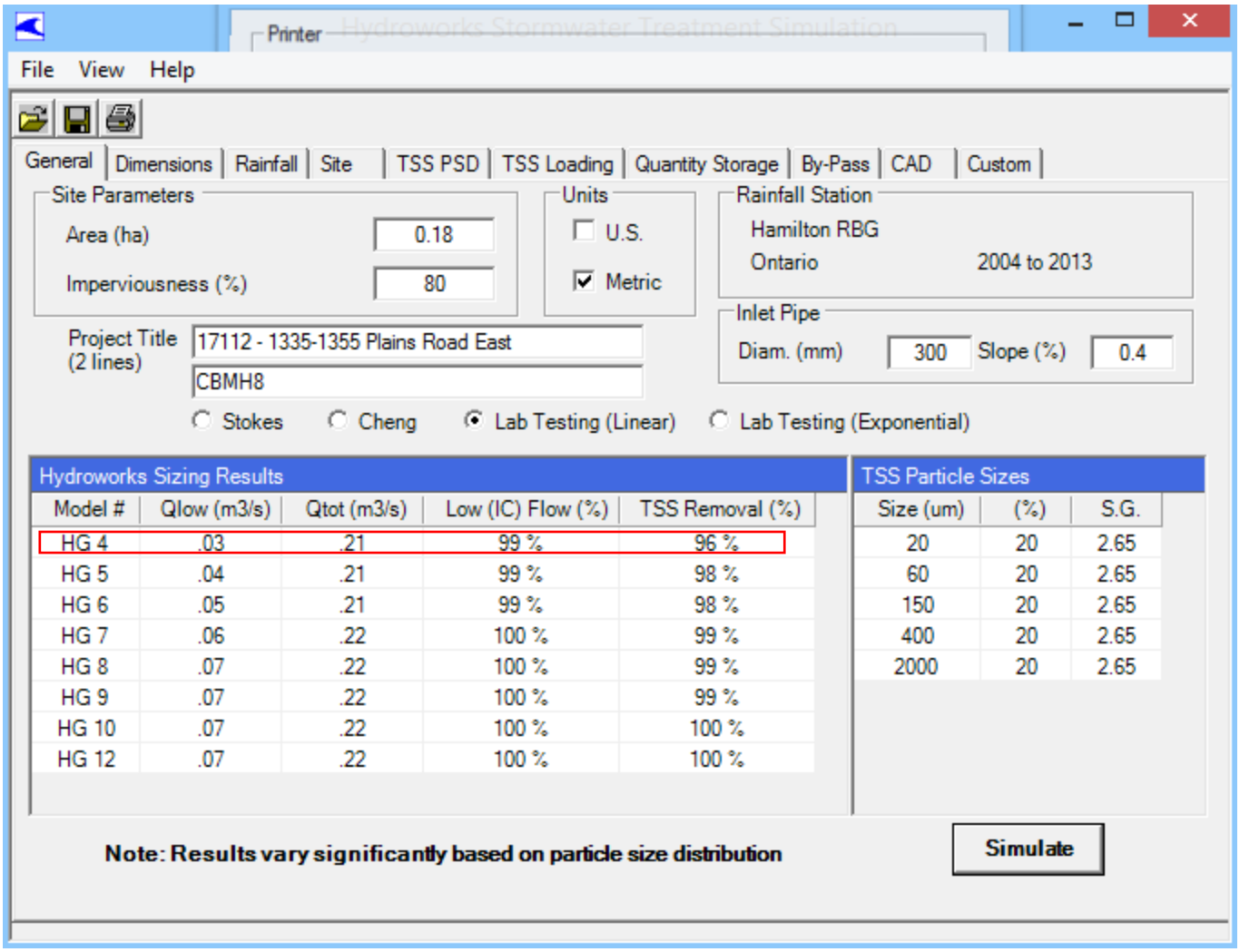
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
100:0008----------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 5 TO 100-YR)
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************

    WARNINGS / ERRORS / NOTES
    -------------------------
  Simulation ended on 2017-12-14     at 17:06:54
================================================================================
```

APPENDIX C
HYDROGUARD INFORMATION


Printer
Hydroworks Stormwater Treatment Simulation
File View Help
General Dimensions Rainfall Site TSS PSD TSS Loading Quantity Storage By-Pass CAD Custom
Site Parameters
Area (ha) 0.13
Imperviousness (%) 84
Units
U.S.
Metric
Rainfall Station
Hamilton RBG
Ontario 2004 to 2013
Inlet Pipe
Diam. (mm) 250 Slope (%) 0.4
Project Title (2 lines)
17112 - 1335-1355 Plains Road East
CB7.1
Stokes Cheng Lab Testing (Linear) Lab Testing (Exponential)
Hydroworks Sizing Results
Model # Qlow (m3/s) Qtot (m3/s) Low (IC) Flow (%) TSS Removal (%)
HG 4 .03 .13 99 % 97 %
HG 5 .03 .13 99 % 98 %
HG 6 .04 .13 100 % 99 %
HG 7 .04 .14 100 % 99 %
HG 8 .04 .14 100 % 100 %
HG 9 .04 .14 100 % 100 %
HG 10 .04 .14 100 % 100 %
HG 12 .04 .14 100 % 100 %
TSS Particle Sizes
Size (um) (%) S.G.
20 20 2.65
60 20 2.65
150 20 2.65
400 20 2.65
2000 20 2.65
Note: Results vary significantly based on particle size distribution
Simulate


Printer
Hydroworks Stormwater Treatment Simulation
File View Help
General Dimensions Rainfall Site TSS PSD TSS Loading Quantity Storage By-Pass CAD Custom
Site Parameters
Area (ha) 0.18
Imperviousness (%) 80
Units
U.S.
Metric
Rainfall Station
Hamilton RBG
Ontario 2004 to 2013
Inlet Pipe
Diam. (mm) 300 Slope (%) 0.4
Project Title (2 lines)
17112 - 1335-1355 Plains Road East
CBMH8
Stokes Cheng Lab Testing (Linear) Lab Testing (Exponential)
Hydroworks Sizing Results
Model # Qlow (m3/s) Qtot (m3/s) Low (IC) Flow (%) TSS Removal (%)
HG 4 .03 .21 99 % 96 %
HG 5 .04 .21 99 % 98 %
HG 6 .05 .21 99 % 98 %
HG 7 .06 .22 100 % 99 %
HG 8 .07 .22 100 % 99 %
HG 9 .07 .22 100 % 99 %
HG 10 .07 .22 100 % 100 %
HG 12 .07 .22 100 % 100 %
TSS Particle Sizes
Size (um) (%) S.G.
20 20 2.65
60 20 2.65
150 20 2.65
400 20 2.65
2000 20 2.65
Note: Results vary significantly based on particle size distribution
Simulate

APPENDIX D
WATER ANALYSIS INFORMATION

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: 17112
Project Name: 1335-1355 Plains Road East
Date: 12-Oct-18

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad \textbf{(1)}$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

	Building Area				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
Building / Location	Footprint Area (m^2)	# of Storeys	**Total GFA (m^2)**	Type of Construction	***Fire Flow "F"*** (l/min)	(l/s)	***Occupancy*** %	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	***Sprinkler*** %	Adjustment (l/min)	***Exposure*** %	Adjustment (l/min)	**(l/min)**	**(l/s)**
1335-1355 Plains Road East Block 1	**894.3**	**1**	**894.3**	**1.0**	7000	116.7	**-15**	-1050.0	**5950.0**	**0**	0.0	50	2975.0	**9000**	**150**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	Calculate for all sides. Maximum charge shall not exceed 75%
3.1 to 10m	20%	
10.1 to 20m	15%	
20.1 to 30m	10%	
30.1 to 45m	5%	

Side	Exposure (m)	Charge (%)
North =	**10.1 to 20m**	**15**
South =	**10.1 to 20m**	**15**
East =	**20.1 to 30m**	**10**
West =	**20.1 to 30m**	**10**
Total Expoure =		***50***

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: 17112
Project Name: 1335-1355 Plains Road East
Date: 12-Oct-18

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad \textbf{(1)}$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

Building / Location	Building Area			Type of	(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
					Fire Flow "F"		*Occupancy*			*Sprinkler*		*Exposure*			
	Footprint Area (m^2)	# of Storeys	**Total GFA (m^2)**	Construction	(l/min)	(l/s)	%	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	%	Adjustment (l/min)	%	Adjustment (l/min)	**(l/min)**	**(l/s)**
1335-1355 Plains Road East Block 2	**2792**	**1**	**2792**	**1.0**	12000	200.0	**-15**	-1800.0	**10200.0**	**0**	0.0	40	4080.0	**14000**	**233**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
30.1 to 45m	5%	exceed 75%

Side	Exposure (m)	Charge (%)
North =	**10.1 to 20m**	**15**
South =	**>45**	**0**
East =	**10.1 to 20m**	**15**
West =	**20.1 to 30m**	**10**
Total Expoure =		***40***

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: 17112
Project Name: 1335-1355 Plains Road East
Date: 12-Oct-18

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad \textbf{(1)}$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

Building / Location	Building Area				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
					Fire Flow "F"		*Occupancy*			*Sprinkler*		*Exposure*			
	Footprint Area (m^2)	# of Storeys	**Total GFA (m^2)**	Type of Construction	(l/min)	(l/s)	%	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	%	Adjustment (l/min)	%	Adjustment (l/min)	**(l/min)**	**(l/s)**
1335-1355 Plains Road East Block 3	**1999.6**	**1**	**1999.6**	**1.0**	10000	166.7	**-15**	-1500.0	**8500.0**	**0**	0.0	45	3825.0	**12000**	**200**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
30.1 to 45m	5%	exceed 75%

Side	Exposure (m)	Charge (%)
North =	**3.1 to 10m**	**20**
South =	**>45**	**0**
East =	**20.1 to 30m**	**10**
West =	**10.1 to 20m**	**15**
Total Expoure =		***45***

APPENDIX E
GEOTECHNICAL INVESTIGATION

SOLA
ENGINEERING

RE: GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
1335, 1349 AND 1355 PLAINS ROAD EAST
BURLINGTON, ONTARIO

FOR: 1967012 Ontario Inc.
c/o S2S Environmental Inc.
1099 Kingston Road, Suite 260
Pickering, ON L1V 1B5

ATTENTION: Ms. Amy Chiang

REPORT NO.: 2017-11151

DATE: December 6, 2017

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Original:	(File No. 10278-S0068-GEO)

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December 6, 2017

REPORT NO.: 2017-11151
FILE NO.: 10278-S0068-GEO

1.0 INTRODUCTION

Sola Engineering Inc. (Sola) was retained by S2S Environmental Inc. (the Client) on behalf of 1967012 Ontario Inc. to carry out a geotechnical investigation and review for the proposed Residential Development located at 1335, 1349 and 1355 Plains Road East in Burlington, Ontario (the "subject site" or "site"). Authorization to proceed with the investigation was received on October 16, 2017 through the acceptance of Sola's Proposal No. 2017-1338RRR.

The Client provide Sola a site plan, Drawing No. A001 and Underground Parking Drawing No. A002, dated July, 26, 2016, prepared by Chamberlain Architect Services Limited.

The Client provide Sola a revised site plan, Drawing No. A001, A001a and A201 dated May 2017, prepared by Chamberlain Architect Services Limited.

It is understood that the Client has carried out an environmental sampling at the subject site in tandem with this geotechnical investigation. As per the scope of services detailed on Sola's Proposal dated October 13, 2017, it is understood that the purpose of this study is to provide recommendations for the design and construction of the proposed residential townhouse development.

This report presents the details of Sola's fieldwork and laboratory testing, outlines the subsoil and groundwater conditions at the subject site, and provides recommendations on the aforementioned items.

This report has been prepared for the Client, and their nominated engineers and designers. Third party use or reproduction, in part or in full, of this report is prohibited without written authorization from Sola. This report is also subject to the Statement of Limitations which forms an integral part of this document.

2.0 SITE SETTING

2.1 SITE LOCATION

The proposed site is located at 1335, 1349 and 1355 Plains Road East in Burlington, Ontario. Site works will consist of the construction of proposed residential development, which consist of thirty-one (31) back-to-back townhouses, nine (9) traditional townhouses with backyards,

accesses road and associated driveways and common Amenity Area. All three (3) blocks will be three (3) storey with no basement level.

2.2 SITE DESCRIPTION

At the time of the fieldwork for this investigation, the site was occupied by several separate lots each containing an existing building, parking lots and driveways. The existing two (2) residential units in the west consist one (1) level underground basement and two (2) commercial units at east have no basement. The subject site is bounded by Helena Street to the North, Glendor Avenue to the East and residential properties to the South and West. The ground surface was generally flat.

3.0 GROUND INVESTIGATION

3.1 SOIL INVESTIGATION

Prior to undertaking field drilling, Sola obtained the clearance of existing public utility services from Ontario One Call and a private locator was arranged by the Client to clear the existing utility services on private property.

The geotechnical investigation was carried out on October 17, 18 and 19, 2017 and comprised of drilling of total sixteen (16) boreholes. Fifteen (15) boreholes (BH1 through BH15) for geotechnical and environmental purpose and one (1) borehole (BH16) for environmental only. All the boreholes were advanced using a truck mounted CME 75 drilling rig. The borehole locations are as shown in Enclosure 1 prepared by the Client. The boreholes were advanced to a maximum depth of 6.5 m below the ground surface (bgs).

Groundwater monitoring wells were installed in Boreholes BH7, BH8 and BH11 through BH16 as per the Client's instructions. Each monitoring well comprised a 50-mm diameter of PVC pipe including a screen section at the lower end with slots. The base of each monitoring well was covered with a PVC cap to prevent the influx of sediments. The slotted section was embedded in a silica sand enclosure, the upper end of which was sealed with bentonite extending to the ground surface.

The boreholes were advanced using a truck mounted, 115 mm diameter solid stem auger drill rig, equipped for soil sampling. Standard Penetration Tests (SPTs) were conducted at frequent depth intervals according to ASTM D-1586. Representative soil samples were recovered from the split spoon sampler used in the SPTs.

The boreholes were advanced using standard geotechnical drilling procedures starting from the

ground surface. All drilling equipment was supplied and operated by Strong Soil Search Inc. of Claremont, Ontario. The drilling works for the geotechnical investigation were completed under the full-time supervision of a qualified Sola Technician.

The soil samples were identified in the field, properly sealed, labelled and brought to the Sola laboratory.

A Sola technologist, under the direction of a Senior Geotechnical Engineer, supervised the fieldwork. The borehole locations were selected by the Client and concurred by Sola. Boreholes were laid out by Sola field personnel.

3.2 GROUNDWATER INVESTIGATION

Groundwater level observations were made during drilling and in the open boreholes upon completion of the drilling operations.

Details pertaining to groundwater observations for each borehole are provided on the respective borehole logs presented in Enclosures 2 through 16. Further discussion on groundwater is provided in **Section 4.2** of this report.

3.3 SURVEY

The existing grade elevations at the borehole locations were surveyed and the survey data provided by the Client for the preparation of this report.

3.4 GEOTECHNICAL FIELD AND LABORATORY TESTING

Standard Penetration Tests (SPTs) were undertaken at selected intervals with depth using a 50 mm outer diameter and 35 mm inner diameter split barrel sampler driven with an automatic hammer of mass 63.5 kg dropping 760 mm in accordance with the ASTM D 1586-11 test method – "The Standard Method of Standard Penetration Testing (SPT)". The results of these tests (SPT "N" values) are presented on the borehole logs in **Enclosures 2 through 16** of this report.

All soil samples were returned to Sola's laboratory for natural moisture content determination. The results of the moisture content are presented in the borehole logs in **Enclosures 2 through 16**. In addition, two (2) representative soil samples, were subjected to particle size analysis, hydrometer analysis and determination of Atterberg Limits. The results of the laboratory tests are presented in **Enclosures 20 and 21**.

4.0 SUBSURFACE CONDITIONS

The detailed descriptions of the sub-soil conditions, encountered at each borehole location, are given in the Borehole Logs in **Enclosures 2 through 16.**

The borehole data collected by Sola represents the subsurface conditions only at the borehole locations. It should be pointed out that the material boundaries indicated on the Borehole Logs are approximate and based on visual observations, and interpolation between successive samples. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should also be noted that the subsurface conditions may vary across the site. A summary of the characteristics of each unit of subsoil encountered within the borehole depths is given in the ensuing paragraphs.

4.1 SOIL CHARACTERISATION

4.1.1 Topsoil

A layer of topsoil was initially encountered at boreholes BH9, BH10 and BH15. The thickness of the topsoil layer varied from 150 mm to 300mm. These boreholes were drilled on landscaped area.

It is important to note that topsoil thicknesses may vary throughout the site area, depending upon their location. As such, these findings should not be relied upon for any estimation of quantities to be stripped prior to construction.

4.1.2 Pavement

Initially, a layer of asphalt pavement was encountered in borehole BH1 through BH8 and BH11 through BH14, ranging in thickness from approximately 25 mm (BH5 and BH14) to 100 mm (BH13). Below the asphalt cover, a granular basecourse layer (sand and gravel) was encountered ranging in thickness from approximately 25 mm (BH12) to 560 mm (BH2).

4.1.3 Fill

A layer of fill was encountered below the topsoil layer and pavement structure at all borehole locations. The depth of fill material extended to the depths between approximately 0.76 m (in BH10) to 1.9 m (in BH14) below the existing grade.

The fill material encountered consisted of sandy silt to silty sand to clayey silt trace gravel

and occasionally with trace of organics or rootlets. In-situ resistance testing results ranged from 3 (BH3) to 26 (BH1) blows per 300 mm of spoon penetration, indicating that the fill was loose to moderately compacted.

The natural moisture content of the soil varied from approximately 4.2% (BH10) to 20.6% (BH14) indicating moist to wet conditions.

It is important to note that fill thicknesses may vary throughout the site area, depending upon their locations. As such, these findings should not be relied upon for any estimation of fill quantities to be stripped prior to construction.

4.1.4 Native Soil

Native soil varying from cohesive soil to till deposits was encountered below the fill layers at all borehole locations.

4.1.4.1. Cohesive Soils

The cohesive soil layers varying from clayey silt to silty clay was encountered in boreholes BH6, BH7 and BH11. The cohesive soils were observed to be brown.

The N-values for cohesive soils was in the range from 4 (BH6) to 18 (BH7) for 300 mm of penetration, suggesting that the soil is soft to very stiff in consistency.

The natural moisture content of the cohesive soil layers was in the range of approximately 15.3% (BH11) to 17.2% (BH7), indicating a moist condition of the layers.

4.1.4.2. Till Deposits

The till deposits varying from clayey silt till to silty clay till were encountered in all the boreholes. The deposits were observed to be brown in the upper horizon turning grey with depth.

The N-values for till deposits were in the range from 16 (BH12) to more than 50 blows for 300 mm of penetration (multiple boreholes), suggesting that the soil is very stiff to hard in consistency.

The natural moisture content of the deposits was in the range of approximately

3.1% (BH4) to 18.6% (BH15), indicating moist to wet conditions of the layers.

All the boreholes were terminated in the till stratum.

4.2 GROUNDWATER CONDITIONS

The boreholes were advanced using a dry auguring system. No seepage water accumulation was found in the boreholes advanced except borehole BH14, where some seepage water was observed during the completion of drilling.

Eight (8) groundwater monitoring wells were installed on October 17, 18 and 19, 2017, in Boreholes BH8, BH9 and BH11 through BH16 to monitor the "stabilized" water levels by the Client. All the water level records including the calculated water level elevations are summarized in **Table 1** below.

Table 1: Summary of Groundwater Levels

Borehole	Cave Depth (m)	Geodetic Elevation at Top of Boreholes	Geodetic Elevation for Groundwater Table
BH1	N/A	99.25	Not a monitoring well
BH2	N/A	99.26	Not a monitoring well
BH3	N/A	99.23	Not a monitoring well
BH4	N/A	99.24	Not a monitoring well
BH5	N/A	99.23	Not a monitoring well
BH6	N/A	98.78	Not a monitoring well
BH7	N/A	99.52	Dry
BH8	N/A	99.49	Dry
BH9	N/A	99.38	Not a monitoring well
BH10	N/A	99.25	Not a monitoring well
BH11	N/A	99.36	Dry
BH12	N/A	99.33	95.51
BH13	N/A	99.35	Dry
BH14	4.26	99.39	97.818
BH15	N/A	99.37	Dry
BH16	N/A	99.38	95.872

It should be noted that water levels can vary in response to seasonal fluctuations and major weather. In addition, a perched water condition can occur due to the accumulation of surface water in the more pervious fill overlying less pervious deposits, especially during seasonally wetter periods.

Based on the above data and the examination of soil samples in the laboratory, in Sola's opinion, the water found in the boreholes may be perched water.

It is recommended that the Client should conduct the hydrogeology investigation.

Once construction commences, the monitoring wells should be decommissioned properly in accordance with prevailing regulations.

5.0 DISCUSSIONS AND RECOMMENDATIONS

It is understood that the existing several structures with unground basement and without basement level will be demolished. The site re-grading may be necessary depending on the design finished grade elevation. The engineered filling may be carried out as per the *"Methodology of Engineered Fill Construction"* presented in **Section 5.8**.

The subject site will be re-developed as proposed residential development, which consist of thirty-one (31) back-to-back townhouses, nine (9) traditional townhouses with backyards, accesses road and associated driveways and a common Amenity Area. All three (3) blocks will be three (3) storey without underground basement level, our recommendations are presented in the following sections.

The investigation and comments should be considered on-going as new information of the underground conditions will continue to become available. For example, when more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must be checked through field inspections carried out by a Geotechnical Engineer to validate the information for use during construction.

5.1 FROST PROTECTION

In Greater Toronto Areas, all footings exposed to seasonal freezing conditions must be buried at a minimum depth of 1.2 m below the ground surface for frost protection.

Where construction is undertaken during winter conditions, footing subgrades should be protected from freezing. Foundation walls and columns should be protected against heave due to soil adfreeze.

5.2 FOOTINGS

5.2.1 Conventional Spread or Strip Footings

At the time of preparation of this report, design loading requirements have not been made available. The following discussions are provided to assist advancing the design phase of the new townhouses development. Based on our understanding, the footings may be positioned at undisturbed native or engineered fill at a depth of approximately 1.2 m to 2.3 m below the existing grade is capable of supporting the foundations for the proposed residential development conventional spread or strip footings

The footings on undisturbed native soil can be designed based on a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa, and a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa at the depths outlined in **Table 2.**

Table 2: Recommended Footing Depths and Soil Bearing Pressures

Borehole	Recommended Depth Below Existing Grade (m)	Bearing Capacities	
		Serviceability Limit State (SLS)	Factored Ultimate Limit State (ULS)
BH1	1.5	150	225
BH2	2.3	150	225
BH3	1.5	150	225
BH4	1.5	150	225
BH5	1.2	150	225
BH6	2.3	150	225
BH7	1.8	150	225
BH8	1.5	150	225
BH9	1.8	150	225
BH10	1.4	150	225
BH11	1.5	150	225
BH12	1.5	150	225
BH13	1.5	150	225
BH14	2.0	150	225
BH15	1.5	150	225

Where it is necessary to place footings on soil at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line (10H:7V) drawn up from

the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

The above design values are provided on the assumption that the allowable bearing pressure at SLS is governed by total and differential settlements of 25 and 19 mm respectively, and the structure will tolerate an angular distortion of 1 in 300.

Prior to pouring the concrete footings, the founding subgrade should be inspected by a Geotechnical Engineer.

5.2.2 Footings on Engineered Fill

The footings supported by the engineered fill, constructed in accordance with the methodology given in **section 6.8**, should be placed at a minimum depth of 300 mm below the finished engineered fill top elevation. These footings may be designed using an allowable soil bearing pressure of 150 kPa (SLS) and 230 kPa (ULS), provided the footings are constructed at an engineered fill age of at least 6 months. For footings constructed less than 6 months waiting periods, the Client is advised to consult Sola for the appropriate allowable soil bearing pressure(s).

The exterior footings on engineered fill should be provided a frost cover of 1.2 m of soil.

Footings and foundation walls supported by the engineered fill should be adequately reinforced by the Project Structural Engineer to minimize the potential of differential settlements.

5.3 Slab-On-Grade And Permanent Drainage

The subgrade preparation constructed as described in Section 6.10.1 would be capable of supporting the slab-on-grade of the proposed development. A granular layer consisting of at least 200 mm of 19 mm Crusher Run Limestone (CRL) or OPSS Granular A should be installed under the floor slab as a bedding layer. The CRL or the OPSS Granular A should be compacted to 100% of its SPMDD.

Such a layer has been proven to be an effective moisture barrier for conventional floor surfaces. However, if special floor coverings such as sheet P.V.C. with heat sealed seams, are considered, either a high efficiency vapour barrier or venting may be added to the granular layer to prevent moisture accumulating between the concrete floor and the P.V.C. flooring. The design of the concrete slabs may be made on the basis of a value of modulus of subgrade

reaction of 20 MPa/m on the surface of the granular base.

Slabs should be constructed separately from any load bearing structural elements.

5.4 VIBRATION MONITORING

The use of vibratory equipment shall be subject to vibratory monitoring and in accordance with the City Bylaws. In some cases, even when the vibration levels are within acceptable limits, it may cause annoyance to the neighbors who may complain to the City, and in turn, the City may not allow the Contractor to use vibratory equipment, especially vibro hammers. In such cases, the Contractor should be prepared to provide alternatives in lieu of vibratory equipment.

5.5 EARTHQUAKE CONSIDERATIONS

Based on the borehole information, for the proposed buildings supported on undisturbed native deposits, the subject site is classified as "Site Class 'D"' for seismic site response according to **Table 4.1.8.4.A** of **Ontario Building Code (OBC)**.

5.6 TEMPORARY SHORING CONSIDERATIONS

Where site space, construction sequence, or surface loading conditions (e.g. traffic) restrict the above-mentioned side slope configurations, the excavation side slope should be appropriately shored to support surface loading during construction.

Where permissible under the *"Occupational Health and Safety Act"*(OHSA), the preferred temporary trench support is generally in the form of trench boxes. Consideration should be given to the time taken between completing the excavation section and installing the trench boxes, as trench boxes need to be installed quickly and efficiently. When a trench box is to be moved, the void space between the outer walls of the trench box and the trench has to be backfilled and compacted, which may require the trench box to be raised sequentially prior to sliding it laterally into its new position.

It is also important to ensure that the trench is not over-excavated so that there is a suitably tight fit between the trench box and the excavated trench walls. Post-construction ground settlements may occur along the line of the trench walls, or adjacent to the excavated trench area, if the excavation is not adequately supported throughout the entire service installation procedure.

The earth pressure acting on the trench box bracing may be evaluated using the earth pressure diagram given on **Section 26** of **Canadian Foundation Engineering Manual (CFEM)**, 4th Edition.

5.7 EARTH PRESSURES

At the time of writing this report, it is not known if shoring will be required to facilitate the construction of the proposed development. It should be noted however, that, if shoring is required, a specialist shoring contractor should be consulted to establish the most appropriate design and seating depths for the temporary shoring solution.

The shoring system may be designed in accordance with the CFEM. Though not a design code, the CFEM design manual provides a comprehensive guide for shoring and anchor design, and still considered the most widely used and accepted design approach in the Greater Toronto Area (herein *"GTA"*).

Shoring subject to unbalanced earth pressures must be designed to resist a pressure distribution that can be calculated as follows:

$$p = K[\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where: p = Lateral earth pressure in kPa acting at depth h

K = parameters are provided below
h = the depth below the ground surface (m)
h_w = the depth below the ground water level (m)
γ = the bulk unit weight of soil, (kN/m^3) use 20.0
γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m^3)
q = equivalent value of surcharge on the ground surface in kPa (min 12 kPa)

The above expression can be simplified by eliminating hydrostatic pressure term on the wall when free draining granular backfill is used and the internal drainage system prevents the build-up of any hydrostatic pressure.

Where the backfill against the buried structure can be drained effectively to eliminate hydrostatic pressure on the wall, this equation can be simplified to:

$$p = K[\gamma h + q]$$

5.8 ENGINEERED FILL

On-site excavated, clean inorganic earth (native and/or fill) may be reused as engineered fill material, provided the moisture contents are strictly controlled.

If imported inorganic mineral soils are used for engineered fill construction, they must meet the applicable environmental guidelines, and their moisture contents should preferably be close to their respective optimum water content values.

For the on-site excavated clean fill/native soils or similar imported soils, heavy compaction equipment should be employed to achieve the specified degree of field density.
Consideration may be also given to backfilling excavations with a well graded, compacted granular soil such as Granular B as it, if thoroughly compacted, would reduce the post construction settlements to an acceptable level and may also expedite the compaction process.

Fill materials required for replacing locally softened soils, or raising grades within the footprint of the structures are to comprise suitably organic free materials approved for use by the Geotechnical Engineer. Fill materials are to be placed in lifts of a maximum thickness of 300 mm and compacted, using appropriate compaction equipment, to 98 % of its Standard Proctor Maximum Dry Density (SPMDD).

Fill located in areas outside of the footprint of any proposed structure or driveway should be compacted to at least 95 % of the material's SPMDD to within 1.0 m of the subgrade level, and then to 98 % of its SPMDD up to the required grade. Imported granular fill used in confined areas should be compacted using only hand-held compaction equipment only.

Sola recommends that any and all engineered subgrades beneath proposed structures are to be inspected and/or proof rolled prior to construction.

5.9 EXCAVATION AND BACKFILL

5.9.1 Excavatability

Based on the findings of the investigation, it is considered that excavation of the overburden fill and native soils at the site can be carried out using a conventional backhoe excavator.

5.9.2 Excavations

It is assumed that the groundwater, if encountered, will be lowered to 0.5 m below the required excavation depth to effect the construction to be carried out in the 'dry'

condition. It is expected that the 'perched water' can be controlled by conventional 'sump and pump' methodology. If more aggressive dewatering methods are required, a dewatering consultant should be consulted. Given the layout of the proposed development in relation to the site area, it has been assumed that all excavations will be open cut in the 'dry'. In order to enable entry into excavations during the construction process, all excavations must comply with the definitions prescribed by the "Occupational Health and Safety Act"(OHSA), Ontario Regulation 213/91 "Construction Projects".

The various soils that will be encountered at this site during construction are classified, as per OHSA, and presented in **Table 3.**

Table 3:Soil Types as per Occupational Health & Safety Act (OHSA)

Soil Description	Soil Types, According to OHSA
Fill	Type 3
Native Soil	Type 2

Based on these definitions, excavation walls within these soils will require battering back at slopes no steeper than 1H (horizontal):1V (vertical). Depending on the construction feasibility, the excavation walls can be supported by temporary shoring systems. During excavations, adjacent existing structures must be protected by proper shoring or sloping. This should be verified by the Geotechnical Engineer when large-scale excavation can be observed safely and with ease.

5.10 CONSTRUCTION CONSIDERATIONS

5.10.1 Site Preparatory Works

The site preparation work should include stripping of the pavement structure, dismantling the existing structures and existing fill in order to develop the required construction or engineered fill subgrades. Stripping depths will likely vary locally and should be adjusted to remove all unsuitable material.

It is recommended that a Geotechnical Engineer monitor the stripping operations to ensure that unsuitable materials have been fully removed prior to construction works or the placement of engineered fill. Unacceptable areas identified are to be remediated as soon as practicable and, the procedures for which would be dependent upon conditions encountered.

Any unsupervised demolished areas must be reworked.

5.10.2 General Considerations

Load bearing soils are susceptible to disturbance from environmental (temperature, moisture change, etc.) and construction activity, as such, due care should be given to minimizing trafficking of such areas during periods of excavation and the construction of floor slab and footings to minimize disturbance of the bearing soils.

Any excessive disturbances of the load bearing and underlying soils affected during construction works could influence the long-term settlement of the structures and will therefore require further excavation and replacement of such impacted soils with suitably engineered fill.

A Geotechnical Engineer should evaluate all subgrade surfaces to confirm that the subgrade and founding conditions are consistent with the recommendations given by this report.

5.11 SERVICE INSTALLATION

At the time of writing this report, there was no information provided to Sola as to the depths of the services or inverts for the pipes. It is assumed that the preliminary service invert subgrade is to comprise of undisturbed, native soils, which is capable of supporting pipes, manholes, etc.

Further information in regards to the construction consideration can be provided when more design details can be made available.

5.12 PAVEMENT

For pavement thickness design, we have made assumptions for the pavement to be constructed over the roof of the basement and/or native ground.

5.12.1 Pavement Thickness Design

For pavement structure supported by the structural roof of the basement, the pavement structure (assuming for heavy duty traffic loading) should consist of the following:

- 50 mm HL1
- 200 mm 25 MPa Portland Cement Concrete (5 to 8% air entrainment)

- 150 mm Granular A base (to be compacted to 100% of the material's standard Proctor maximum dry density (SPMDD))
- (Roof Structure by others)

Undisturbed native ground, the existing fill soils (re-compacted as required under Sola's supervision) and new engineered fill (if constructed) can support the proposed access road and driveway pavements. Transitions between different subgrade types must be prepared to include a 3H:1V profile to avoid differential settlement.

It is anticipated that the final subgrade will comprise predominantly on-site re-engineered soils. Accordingly, in view of the frost susceptibility and drainage characteristics of the final subgrade soils and the expected volume of traffic for a residential development, the following pavement designs presented in **Table 4** are recommended.

Table 4: Recommended Pavement Design (New Construction)

Pavement Component	Driveway Thickness (mm)	Compaction Requirements
Asphaltic Concrete Surface Course (HL-3)	40	Minimum of 92.0% of Maximum Relative Density (MRD)
Asphaltic Concrete Binder Course (HL-8)	80	Minimum of 92.0% of Maximum Relative Density (MRD)
Granular Base (20 mm Crusher Run Limestone or OPSS Granular A)	150	100% SPMDD
Granular Sub-base (50 mm Crusher Run Limestone or OPSS Granular B-Type 1)	300	100% SPMDD

The 20 mm Crusher Run Limestone (CRL) shall meet the Ontario Provincial Standard Specification (OPSS) for Granular A. The 50 mm CRL shall meet the OPSS for Granular B "Type I" gradation specification. The granular base and subbase should be compacted to at least 100% of their SPMDD.

The asphaltic concrete courses are to be hot-mixed and hot-laid in accordance with current OPSS specifications, Forms 310 and 1150 (Ontario PGAC grades PG 58-28 equivalency), and compacted to a minimum of 92% of Maximum Relative Density (MRD).

The pavement design as presented above is based on the assumption that construction will be undertaken under dry weather conditions and that the subgrade is stable and not heaving under construction equipment traffic. However, if the construction conditions are non-ideal, with the final subgrade being wet and/or unstable, additional imported subbase material may become necessary.

The pavement make-up for the entrance driveways from city roads should match the respective road pavement design at the road/driveway interface.
Prior to placing the granular subbase, the final subgrade should be proof-rolled to identify soft spots, if any, and rectified as required in consultation with a Geotechnical Engineer from Sola.

The recommended pavement structure should be considered for preliminary design purposes only. A functional design life of eight (8) to ten (10) years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure can be designed based on specific traffic data and design life requirements. Such further analysis will also involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific traffic loading data input from the Client.

Pavement Drainage: The ability of the soils to provide adequate subgrade support is reduced if allowed to become too wet. Therefore, in order to intercept infiltrating water and provide drainage of the subgrade and pavement material, it is recommended that 100 mm diameter sub-drains, wrapped in filter cloth, be provided along both sides of the driveways. Furthermore, the subgrade should be graded to promote flow of water towards the subdrains.

5.12.2 Pavement Construction Considerations

For pavement construction, the subgrade must be compacted to at least 98 % of its SPMDD for at least the upper 300 mm unless an alternative is approved by Sola.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Additional comments on the construction of pavement areas are as follows:

- The subgrade preparation should include stripping of any objectionable

materials, e.g. loose fill with organics. The base should be properly shaped and thoroughly proof rolled using a loaded truck. Soft and/or unstable subgrade areas should be further sub-excavated and backfilled to the design subgrade level using approved material, placed in thin lifts and compacted to 98% of its SPMDD;

- The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed grading. Assuming that satisfactory crossfalls in the order of 3.0% have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that flatter crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by Sola; and,
- The most severe loading conditions on the pavement areas and subgrade may occur during construction. Consequently, special provisions such as restricted access routes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.

It is recommended that Sola be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations in this report.

6.0 CLOSURE

This report is subject to the Statement of Limitations which forms an integral part of this document. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Sola, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

We trust that this report meets your needs. Should you have any queries, please contact the Sola office.

Sincerely
SOLA ENGINEERING INC.

Kuljit S. Brar P. Eng.

LICENSED PROFESSIONAL ENGINEER
B. FENG
100050651
PROVINCE OF ONTARIO

Bill Feng, P. Eng.

\\SERVER02\Company\PROJECTS\10278-(1338RR)-S2S-GEO-Residential-1335 through 1355 Plains Rd E Burlington-Sep\GEO\08 Draft Reports\2017-11151-10278-S0068-GEO-Final.docx

Enclosures

STATEMENT OF LIMITATIONS

Standard of Care and Basis of this Report
Sola Engineering Inc. ("Sola Engineering") has prepared this report in a manner consistent with generally accepted engineering and/or environmental practices in the jurisdiction in which the specified services were provided. The information and conclusions set out in this report reflects Sola Engineering's best professional judgment in light of the information available to Sola Engineering at the time of preparation. Sola Engineering disclaims any and all warranties, express or implied, including without limitation any warranty of merchantability and/or fitness for a particular purpose, and makes no representations concerning the legal effect, interpretation or significance of this report or the information, conclusions or recommendations contained in it.

The conclusions and recommendations provided in this report have been prepared in relation to the specified site (the "Site") and the proposed project (the "Project"), as described by the Client to Sola Engineering. Given the nature of the work undertaken by Sola Engineering as part of this report, the Client acknowledges that ground conditions may vary over distances and may change over time. Should there arise any changes to the conditions of the Site or the Project (as to purpose or design), Sola Engineering is to be notified within a reasonable period of time, and in any event within 24 hours of the Client's learning of such changes, so as to give Sola Engineering an opportunity to review and revise this report in light of such changes. Sola Engineering accepts no liability or responsibility for any use of this report or reliance on this report following any changes to the conditions of the Site or the Project.

The scope of professional services provided by Sola Engineering for the Project are as set out in this report. Should such services be limited to those of a geotechnical nature, Sola Engineering shall not be held liable or responsible for any environmental services that may be required, nor shall this report be interpreted to reflect any environmental aspects of the Project. Alternatively, should such services be limited to those of an environmental nature, Sola Engineering shall not be held liable or responsible for any geotechnical services that may be required, nor shall this report be interpreted to reflect any geotechnical aspects of the Project.

This report is not intended to provide recommendations for possible future conditions or use of the Site or adjoining properties. Should the need arise for such recommendations Sola Engineering may need to conduct further investigations.

Use of this Report
This report is intended to be read and used in its entirety. No reliance may be made upon any individual portion or section of this report without reference to the entire report as a whole. In preparing this report, Sola Engineering has relied on information, instructions and communications given by the Client to Sola Engineering, the applicability, truth and accuracy of which is the sole responsibility of the Client.

This report with the information, sampling data, analysis, conclusions and recommendations contained in it (if any), has been prepared for and may only be used by the Client and only for the specific purpose as specified by the Client to Sola Engineering in connection with the Project. Without prior written consent from Sola Engineering, use of this report or any portion thereof by any person or entity other than the Client, or for any purpose other than as communicated by the Client to Sola Engineering, is strictly prohibited. Sola Engineering accepts no liability or responsibility for the unauthorized use of this report. This report and all documents that form part of it are the sole property of Sola Engineering. Sola Engineering relies on and retains any and all intellectual property rights it has in this report, including any copyright to which it is entitled. The Client shall not give, lend or sell this report, or any portion thereof, to any entity, person or association without the express prior written consent of Sola Engineering. This report and the information contained herein shall be treated as strictly confidential.

The contents of this report, inclusive of Sola Engineering's conclusions and recommendations in relation to the Project, are intended only for the guidance of the Client in carrying out the specified services for the Project, as described by the Client to Sola Engineering. Accordingly, Sola Engineering does not accept any liability or responsibility for any inaccuracy contained in this report arising as a result of or in any way connected with any exclusion, oversight or falsification of the information provided to Sola Engineering by the Client. This report, including the effect of the subsurface conditions as described in this report, is to be interpreted at the risk and discretion of the Client and any contractors or others bidding on or undertaking contractual work to be performed as part of the Project who may come into possession of or learn of this report or its contents. It is exigent that all contractors bidding or undertaking the work are to rely on their own interpretations of the data contained in this report in addition to their own investigations and conclusions. Sola Engineering shall not be held liable or responsible for any interpretation of or conclusions that may be drawn from the data or information contained in this report.

The information, recommendations and conclusions presented in this report are based on Sola Engineering's interpretation of conditions revealed through the limited investigation conducted within a defined scope of services. In no event will Sola Engineering be held responsible or liable to the Client or any other person or entity for any special, indirect, incidental, punitive or consequential loss or damage (including, loss of use, lost profits or expenses incurred) resulting from or in any way related to the independent interpretations, interpolations, conclusions or decisions of the Client or any other person or entity, based on the information contained in this report. The restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Notwithstanding the exclusions of liability contained herein but without in any way limiting their effect or generality, if there is found to be any finding of liability or responsibility whatsoever on the part of Sola Engineering which in any way relates to or arises from this report, or the information, conclusions or recommendations contained in it, such liability and/or responsibility shall cease and forever be extinguished from and after the date which is two (2) years from the date of this report. In no event shall any liability or responsibility of Sola Engineering exceed the fees charged by Sola Engineering to the Client for the preparation of this report (excluding any arms' length disbursements or expenditures made or incurred by Sola Engineering as a result thereof and reimbursed by the Client).

Site Conditions
The material conditions, classifications, conclusions and recommendations contained in this report were based on the site conditions observed or tested by Sola Engineering or otherwise communicated to Sola Engineering by the Client. The description, identification and classification of soils, rocks, chemical contamination and other materials have been made based on limited investigations, sampling and testing of materials performed by Sola Engineering and its qualified representatives in reliance on the use of relevant or applicable equipment, all in accordance with commonly acceptable standards in the geotechnical and/or environmental disciplines. Accordingly, this report may include assumptions of conditions which are based on discrete sample locations and thus some conditions may not have been detected. The Client accepts all liability and risk for the use of this report and the information and data contained in it. Sola Engineering shall not be held liable or responsible for any conditions beyond the scope of tests conducted on samples of the subsurface and soil conditions of the subject property as set out in this report.

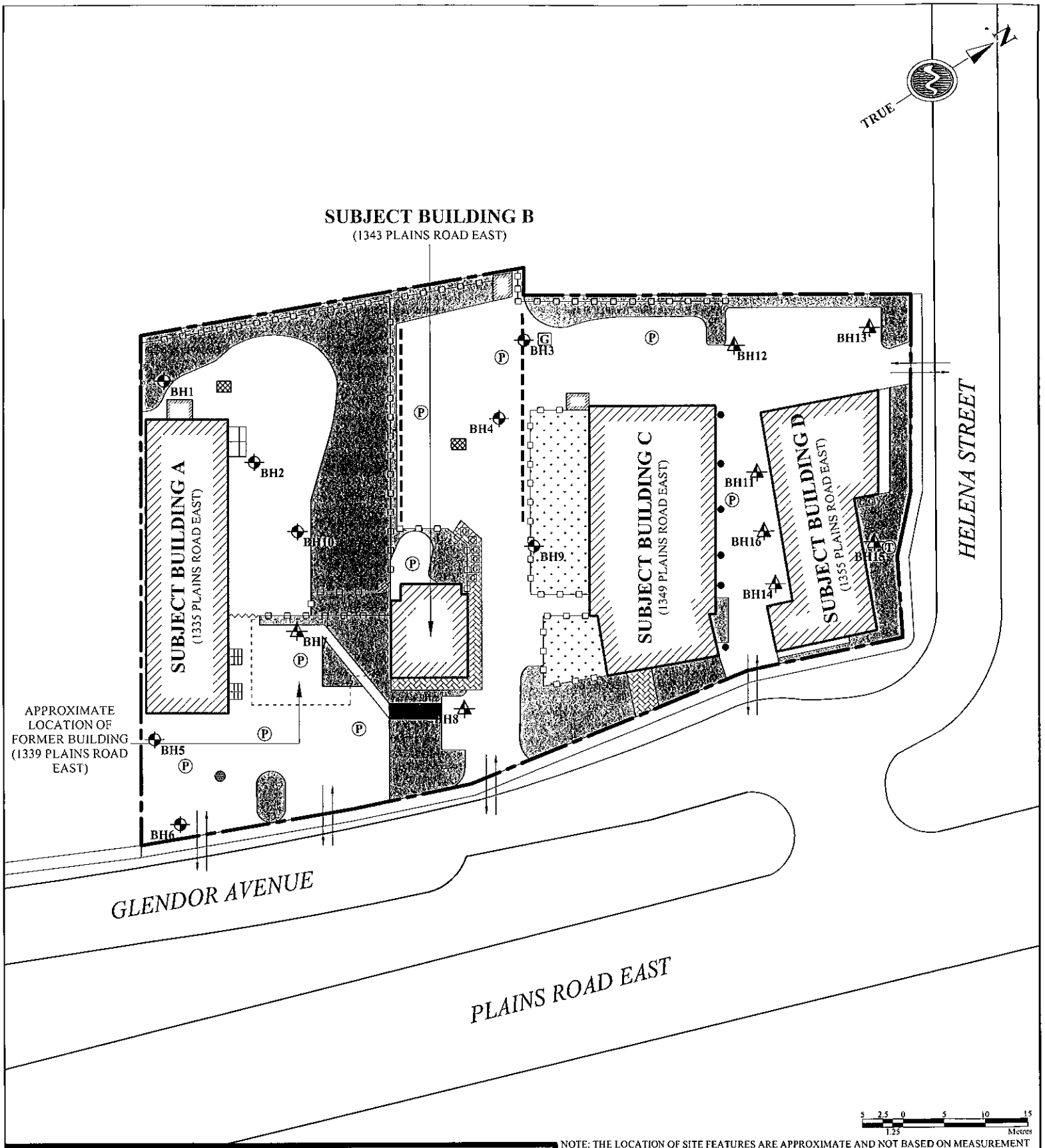
For clarity, the Client acknowledges and accepts that unique risks exist whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive sampling and testing program may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical and hydrogeological conditions that Sola Engineering interprets to exist between sampling points may differ from those that actually exist. As a result, the Client acknowledges and accepts that because of the inherent uncertainties in subsurface evaluations, unanticipated underground conditions may occur or become known subsequent to Sola Engineering's investigation that could affect conclusions, recommendations, total Project cost and/or execution.

Indemnification of Risk
Though Sola Engineering adheres to the highest degree of integrity and employs due diligence in limiting the potential release of toxins and hazardous substances, the risk of accidental release of such substances is a possibility when providing geotechnical and environmental services.

In consideration of the provision of services by Sola Engineering, the Client agrees to defend, indemnify and hold Sola Engineering and its employees and agents harmless from and against any and all claims, liabilities, damages, causes of action, judgments, costs or expenses (including reasonable legal fees and disbursements), resulting from or arising by reason of the death or bodily injury to persons, damage to property, or other loss, whether related to an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project or otherwise, and whether or not resulting from Sola Engineering's negligent actions or omissions. This indemnification shall include and extend to any and all third party claims brought or threatened against Sola Engineering under any federal or provincial law or statute as a result of Sola Engineering conducting work on the Project. In addition to and notwithstanding the foregoing, the Client further agrees to unconditionally and irrevocably release Sola Engineering from, and not to bring any claims against Sola Engineering in connection with, any of the aforementioned claims or causes.

Subconsultants and Contractor Services
In conjunction with the services provided by Sola Engineering's own employees, external services provided by other persons or entities that are specializing in services other than those offered by Sola Engineering, such as drilling, excavation and laboratory testing, are often employed in order to carry out the defined scope of work. If such external services have been employed for this Project, the Client acknowledges that Sola Engineering is not in any way liable or responsible for any costs, claims or damages in relation to the services rendered by such other persons or entities or payment therefor, nor shall Sola Engineering be liable or responsible for damages for errors, omissions or negligence caused by such other persons or entities while providing such external services.

Work and Job Site Safety
Sola Engineering shall be responsible only for its activities and that of its employees on the Site. Sola Engineering shall not direct any of the fieldwork nor the work of any other person or entity on the Project. The presence of Sola Engineering staff on the Site does not relieve the Client or any contractor on the Site from their responsibilities pertaining to site safety. The Client at all times retains any and all responsibility for the safety of those individuals present on the Site and/or working on the Project, including Sola Engineering's employees.



NOTE: THE LOCATION OF SITE FEATURES ARE APPROXIMATE AND NOT BASED ON MEASUREMENT AND ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.

LEGEND

- ASSUMED PROPERTY LINE
- SITE ACCESS
- PRE-CAST CONCRETE CAR STOPS
- WOODEN FENCE
- EXTERIOR CONCRETE STAIRS WITH METAL BAR RAILING
- EXTERIOR METAL STAIRS WITH METAL BAR RAILING
- (P) ASPHALT PAVED PARKING AND DRIVEWAY
- CATCH BASIN
- [G] GARBAGE BIN
- MANHOLE
- APPROXIMATE LOCATION OF BOREHOLE
- SUBJECT BUILDING
- SHED
- CONCRETE WALKWAY
- LANDSCAPED AREA
- PLAYGROUND AREA
- INTERLOCKING BRICK
- CONCRETE PAVERS
- CONCRETE BOLLARDS
- APPROXIMATE LOCATION OF BOREHOLE

S2S Environmental Inc.		SCALE: AS SHOWN
PROJECT NO: 7072	SITE LOCATION: 1335-1355 PLAINS ROAD EAST TORONTO, ONTARIO	DRAWING NO: 1

SITE PLAN SHOWING BOREHOLE/ MONITORING WELL LOCATIONS

DATE: NOV 03, 2017 | DRAWN BY: YP

ENCLOSURE 2
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 1

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.25 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KK **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. / M.C. / "N" Value 20 40 60 80
99 (0)		1	ASPHALTIC CONCRETE - 40 mm Sand and Gravel - 140 mm	12.8	6-7-8-7	15		
			FILL - silty sand, trace clay, red, moist	11.6				
98 (1)		2		8.4 14.4	3-10-16-17	26		
		3	SILTY CLAY TILL - trace gravel, brown, very stiff, moist	11.5	3-10-11-13	21		
97 (2)		4		10.3	5-6-11-14	17		
96 (3)		5	- grayish brown	7.0	6-11-17-40	28		
95 (4)								
94 (5)		6	- hard	9.4	12-25-30-35	55		
			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93 (6)								
92 (7)								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 3
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 2

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.26 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99 (0)		1	ASPHALTIC CONCRETE - 50 mm Sand and Gravel - 560 mm	3.2	7-8-6-6	14		
98 (1)		2	Crusher Run Lomestone (2")	3.8	3-3-3-5	6		
		3	FILL - clayey silt, trace gravel, brown, wet	6.9 14.4	3-4-2-3	6		
97 (2)		4	SILTY CLAY TILL - trace gravel, brown, very stiff to hard, moist	15.4	3-7-13-50****/8	20		
96 (3)		5		11.3	8-12-26-26	38		
95 (4)								
94 (5)		6		9.3	16-22-31-33	53		
			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93 (6)								
92 (7)								

Notes: 50****/8 denotes 50 plus blows for 8 cm of sampler penetration after first 45 cm;

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 4
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 3

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 18, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.23 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. / M.C. / "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99		1	ASPHALTIC CONCRETE - 50 mm Sand and Gravel - 250 mm	4.1	5-3-2-2	5		
			FILL - sandy silt, trace clay, red, wet	9.5				
			- trace gravel	7.1	2-1-2-3	3		
98		2	SILTY CLAY TILL - trace gravel, trace sand, brown, soft, highly moist	20.8				
		3	CLAYEY SILT TILL - trace gravel, trace sand, brown, stiff, moist	17.3	5-6-6-8	12		
97		4	SILTY CLAY TILL - trace gravel, brown, very stiff, moist	11.7	6-8-12-16	20		
			- trace sand, hard					
96		5		9.3	10-19-37-28	56		
95								
94		6		10.8	11-20-27-29	47		
			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93								
92								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 5
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 4

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 18, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.24 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99 (0)		1	ASPHALTIC CONCRETE - 50 mm Sand and Gravel - 250 mm	1.7	7-5-4-4	9		
			FILL - sandy silt, trace rootlets, trace clay, red, moist	14.3				
98 (1)		2		16.8	3-4-2-4	6		
		3	SILTY CLAY TILL - trace gravel, brown, very stiff, moist	12.4	7-8-11-13	19		
97 (2)		4		3.1	5-8-14-14	22		
			- trace sand					
96 (3)		5		10.6	10-21-27-47	48		
95 (4)								
94 (5)		6		13.9	10-22-26-32	48		
			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93 (6)								
92 (7)								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 6
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 5

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 18, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.23 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Stong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99		1	ASPHALTIC CONCRETE - 25 mm Sand and Gravel - 400 mm	4.0	6-3-2-2	5		
			FILL - silty sand, red, moist	13.0				
98		2	- trace clay SILTY CLAY TILL - trace gravel, brown, very stiff, moist	17.1 15.9	1-6-13-19	19		
97		3		15.9	7-12-16-20	28		
		4	- brownish grey	12.6	6-9-12-18	21		
96		5	- reddish brown, hard	11.3	8-12-30-37	42		
95								
94		6	- grey	13.8	10-16-22-32	38		
			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93								
92								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 7
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 6

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 98.78 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
98.78 / 0		1	ASPHALTIC CONCRETE - 40 mm Sand and gravel - 150 mm	3.8	6-4-4-4	8		
98 / 1		2	FILL - silty clay, brown, moist - clayey silt, with sand, red, wet	14.3 18.5	1-2-2-4	4		
97 / 2		3	CLAYEY SILT - trace sand, brown, soft, highly moist SILTY CLAY TILL - trace gravel, greyish brown, soft, highly moist	16.7 17.2	1-1-3-5	4		
96 / 3		4	- hard, moist		5-13-18-23	31		
95 / 4		5		8.7	13-22-28-32	50		
94 / 5		6	- silty sand seems, grey	9.7 10.2	13-17-22-50*/13	39		
93 / 6			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
92 / 7								

Notes: 50*/13 denotes 50 plus blows for 13 cm sampler penetration after 1st 45 cm;

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 8
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 7

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 18, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.52 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Stong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99.52 (0)		1	ASPHALTIC CONCRETE - 50 mm Sand and gravel - 300 mm	9.0	7-8-6-9	14		
99 (1)		2	FILL - silty sand, trace organic, reddish brown, moist	9.9	3-3-3-5	6		
			- trace clay	18.2				
98 (2)		3	SILTY CLAY - trace rootlets, brown, very stiff, moist	16.5	6-8-10-14	18		
97 (3)		4	SILTY CLAY TILL - trace gravel, brown, very stiff, moist	16.1	5-10-13-19	23		
96 (4)		5		11.0	7-16-20-21	36		
95 (5)		6		11.0	10-16-21-26	37		
94 (6)			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.					
93 (7)								
92								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 9
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 8

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 18, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.49 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
99 / 0		1	ASPHALTIC CONCRETE - 50 mm Sand and Gravel - 250 mm	1.6	5-4-3-4	7		
			FILL - silty sand, reddish brown, moist	14.3				
98 / 1		2		20.4	2-4-4-4	8		
		3	SILTY CLAY TILL - trace gravel, brown, very stiff, moist	16.0	4-7-12-13	19		
97 / 2		4		17.4	5-7-12-17	19		
96 / 3		5		13.5	4-12-16-17	28		
95 / 4								
94 / 5		6	- trace shale fragments, hard	10.2	12-19-27-26	46		
93 / 6			End of borehole at target depth of 5.18 m; The borehole was open and dry upon completion of drilling					
92 / 7								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 10
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 9

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.38 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Soliod Stem
DRILLER: Strong Soil inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. / M.C. / "N" Value 20 40 60 80
99 / 0		1	TOPSOIL - 150 mm	20.3	1-4-4-4	8		
			FILL - sandy silt, trace clay, trace organic, reddish brown, moist	16.9				
98 / 1		2	- silty clay, brown, wet	18.0	0-1-6-8	7		
			FILL - silty sand, red, wet	17.3				
97 / 2		3	SILTY CLAY TILL - trace gravel, brown, stiff, moist	20.1 / 18.4	5-6-8-9	14		
		4		12.9	3-6-11-12	17		
96 / 3		5		11.4	8-15-20-23	35		
95 / 4								
94 / 5		6		11.0	8-22-30-30	52		
93 / 6			End of borehole at target depth of 5.18 m; The borehole was open and dry upon completion of drilling					
92 / 7								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 11
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 10

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.25 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. / M.C. / "N" Value 20 40 60 80
99 / 0		1	TOPSOIL - 150 mm	13.4				
			FILL - silty sand, brown, moist	4.2	2-4-8-10	12		
			- sandy silt, red, compact, moist					
98 / 1		2		14.8	5-7-10-12	17		
			SILTY CLAY TILL - trace gravel, grayish brown, hard, moist					
		3		14.8	8-14-16-18	30		
97 / 2			- very stiif to hard					
		4		15.9	5-11-17-20	28		
96 / 3		5		10.6	9-18-22-25	40		
95 / 4								
94 / 5		6		9.8	15-22-30-38	52		
			End of borehole at target depth of 5.18 m; The borehole was open and dry upon completion of drilling					
93 / 6								
92 / 7								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 12
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 11

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 17, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.36 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99 (0)		1	ASPHALTIC CONCRETE - 40 mm Sand and Gravel - 560 mm	2.3	12-9-9-10	18		
98 (1)		2	FILL - silty sand, brown, moist	17.5	0-1-3-7	4		
			SILTY CLAY - trace sand, brown, soft, moist					
97 (2)		3	SILTY CLAY - trace gravel, brown, very stiff, moist	15.3	5-7-9-12	16		
		4	CLAYEY SILT TILL - trace gravel, brown, very stiff, moist	13.4	4-7-10-16	17		
96 (3)		5	SILTY CLAY TILL - some gravel, trace shale fragments, reddish brown, hard, slightly moist	11.4	6-9-24-31	33		
95 (4)								
94 (5)		6	SILTY CLAY TILL - trace gravel, dark brown, hard, slightly moist	11.2	10-16-23-30	39		
93 (6)			End of borehole at target depth of 5.18 m; The borehole was open and dry upon completion of drilling					
92 (7)								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 13
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 12

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 19, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.33 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): 3.82 **DRILLING METHOD:** Solid Stem
DRILLER: Strong soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99		1	ASPHALTIC CONCRETE - 50 mm Sand and Gravel - 25 mm	3.0	7-6-7-7	13		
			FILL - silty sand, grey, moist	7.7				
98		2	- reddish brown, wet	14.3	2-2-7-13	9		
		3	SILTY CLAY TILL -trace gravel, brown, very stiff, moist	14.6	5-7-9-11	16		
97		4		12.0	5-8-20-25	28		
96		5	- hard	8.8	14-28-39-36	67		
95		6		10.5	11-26-13-50*/13	50*		
94			End of borehole due to spoon refusal at 5.16 m; Borehole was open and dry upon completion of drilling.					
93								
92								

Notes: 50*/13 denotes 50 plus blows for 13 cm sampler penetration after 1st 45 cm;

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 14
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 13

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 17, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.35 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ---- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
99			ASPHALTIC CONCRETE - 100 mm Sand and Gravel - 125 mm	4.2				
		1	FILL - silty sand, reddish brown, moist	10.3	4-4-3-3	7		
		2		19.2	1-2-2-7	4		
98			SILTY CLAY TILL - trace gravel, brown, soft, moist	18.1				
		3		15.6	6-8-12-12	20		
97		4		11.0	4-12-20-24	32		
96		5	- trace shale fragments, hard	9.7	12-20-30-32	50		
		6		10.1	9-18-30-29	48		
95		7		8.1	12-18-28-42	46		
94								
93		8	SILTY CLAY TILL - grayish brown, hard, slightly moist	14.8	20-36-50*/14	50*		
			End of borehole due to spoon refusal at 6.53 m; Borehole was open and dry upon completion of drilling					
92								

Notes: 50*/14 denotes 50 plus blows for 14 cm sampler penetration after 1st 30 cm;

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 15
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 14

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 17, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.39 Geodatic **CAVED AT DEPTH (M):** 4.26
WATER LEVEL DEPTH (M): 1.57 **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
99		1	ASPHALTIC CONCRETE - 25 mm Sand and Gravel - 650 mm	7.5	6-9-9-3	18		
98		2	FILL - silty sand, trace clay, reddish brown, wet	17.5	2-3-3-4	6		
		3	FILL - silty sand, reddish brown, moist	20.6	3-5-8-8	13		
97		4	SILTY CLAY TILL - trace gravel, brown, stiff, moist - very stiff to hard	16.0 12.8	5-9-12-13	21		
96		5		9.6	6-13-10-23	23		
95		6		9.9	8-18-29-35	47		
94		7		9.6	14-30-40-50*/13	50*		
93			End of borehole due to spoon refusal at 5.17 m; Borehole caved at 4.26 m and water level at 3.81 upon completion of drilling					
92								

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 16
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 15

SOLA ENGINEERING

PROJECT NO.: 10278 **DATE:** October 17, 2017
PROJECT: Proposed Residential Development

CLIENT: 1967012 Ontario Inc. c/o S2S Environmental Inc.
LOCATION: 1335,1349 and 1355 Plains Road East, Burlington, ON
ELEVATION (M): 99.37 Geodatic **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): ----- **DRILLING METHOD:** Solid Stem
DRILLER: Strong Soil Inc. **DRILL RIG:** CME 75
LOGGED BY: KA **REVIEWED BY:** KB

LEGEND:
- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- STABILIZED WATER LEVEL
- CAVED AT
- "N" BLOWS / 0.3 M
- M.C. NATURAL MOISTURE CONTENT (%)
- O.V.M ORGANIC VAPOUR MONITOR
- P.L. PLASTIC LIMIT (%)
- L.L. LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)
					BLOW COUNTS	"N" VALUE	
99		1	TOPSOIL - 300 mm	22.6	1-2-3-3	5	99
			FILL - silty sand, reddish brown, moist	11.3			
			- trace clay				
98		2		14.6	1-2-3-9	5	98
			SILTY CLAY TILL - trace gravel, brown, very stiff, moist				
		3		18.6	4-7-10-12	17	
97		4		14.9	5-9-12-17	21	97
			- hard				
96		5		12.5	7-8-26-35	34	96
			- slightly moist				
95		6		12.2	8-21-27-28	48	95
		7		11.3	9-19-23-38	42	
94			End of borehole at target depth of 5.18 m; Borehole was open and dry upon completion of drilling.				94
93							93
92							92

P.L.-L.L. M.C. "N" Value 20 40 60 80

Notes:

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

KEY TO SYMBOLS

Enclosure 17

Symbol	Description
Strata symbols	
	Pavement
	Fill
	Silty clay till
	Fill clayey
	Clayey silt till
	Clayey silt
	Silty clay
	Topsoil

Symbol	Description
	Description not given for: "FFF"
	Description not given for: "CZCZ"
Misc. Symbols	
△	Natural Moisture Content
	Stabilized Water Level
	Drill Refusal
	Description not given for: "RNOTE1"
Soil Samplers	
	Split Spoon

Notes:

Terms describing RELATIVE DENSITY, based on Standard Penetration Test "N"-Value for COURSE GRAINED soils (major portion retained on No. 200 sieve).

DESCRIPTIVE TERM ["N"-Value (blows/0.3m), Relative Density (%)]

- Very Loose [less than 4, less than 15]
- Loose [4 to 10, 15 to 35]
- Compact or Medium [10 to 30, 35 to 65]
- Dense [30 to 50, 65 to 85]
- Very Dense [greater than 50, greater than 85]

Terms describing CONSISTENCY, based on Standard Penetration Test "N"-Value for FINE GRAINED soils (major portion passing No. 200 sieve)

DESCRIPTIVE TERM [Unconfined Compressive Strength (kPa), "N"-Value (blows/0.3m)]

Very Soft [less than 25, less than 2]
Soft [25 to 50, 2 to 4]
Firm [50 to 100, 4 to 8]
Stiff [100 to 200, 8 to 15]
Very Stiff [200 to 400, 15 to 30]
Hard [greater than 400, greater than 30]

KEY TO SYMBOLS

Enclosure 17

Symbol Description

Soil Samplers



Description not given for:
"AS"

Monitor Well Details

Flush-mount
Cover



Pipe Riser



Bentonite Slurry



Silica sand, Blank PVC



Slotted Pipe w/ Sand



No Pipe, Sealed



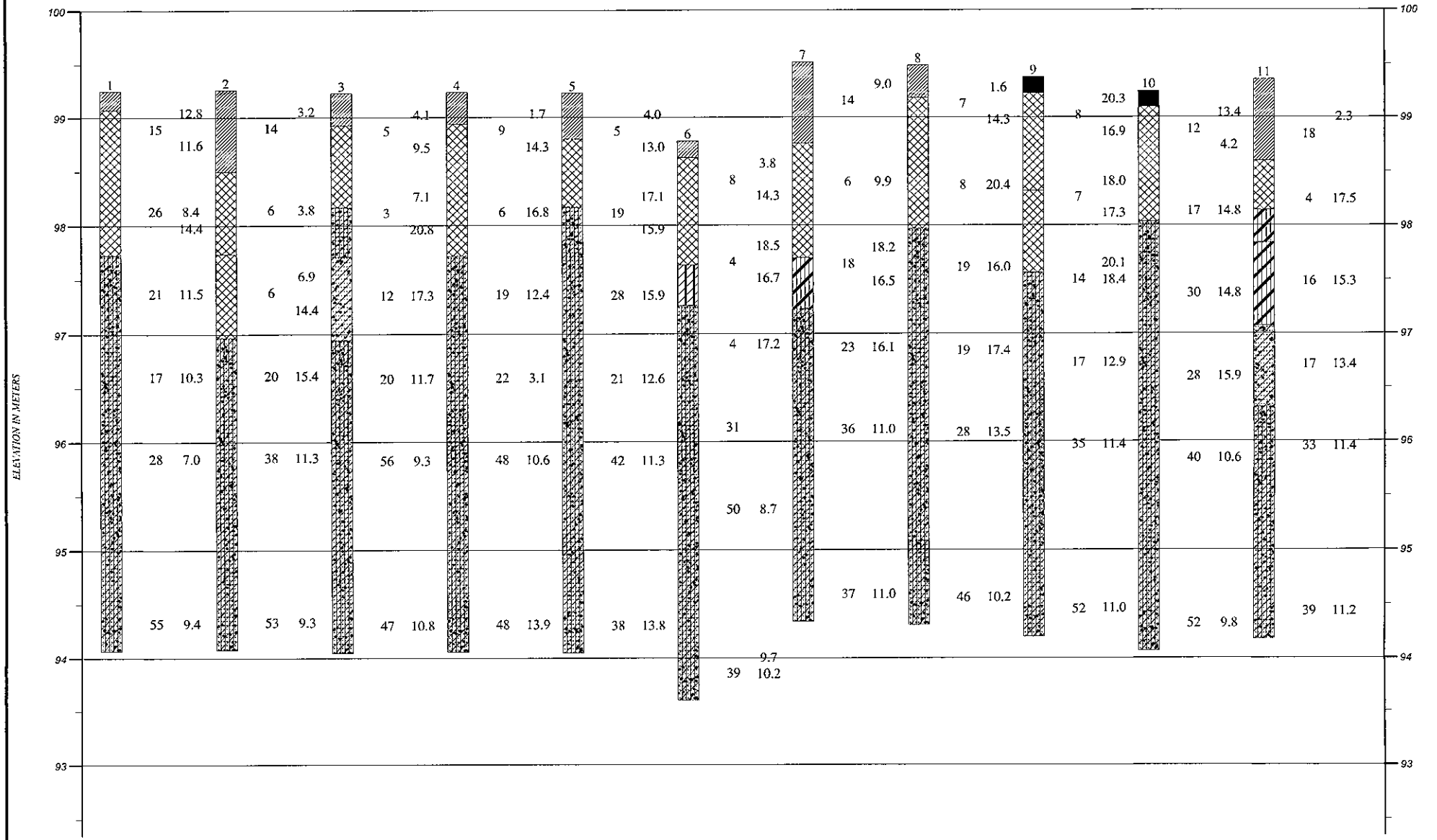
Bentonite Pellets



Silica Sand, No Pipe
(End Plug)



No Pipe, Filler Material



Plan View

Strata symbols

- Pavement
- Fill
- Silty clay till
- Fill clayey
- Clayey silt till
- Clayey silt
- Silty clay
- Topsoil
- Description not given for: "FFF"
- Description not given for: "CZCZ"

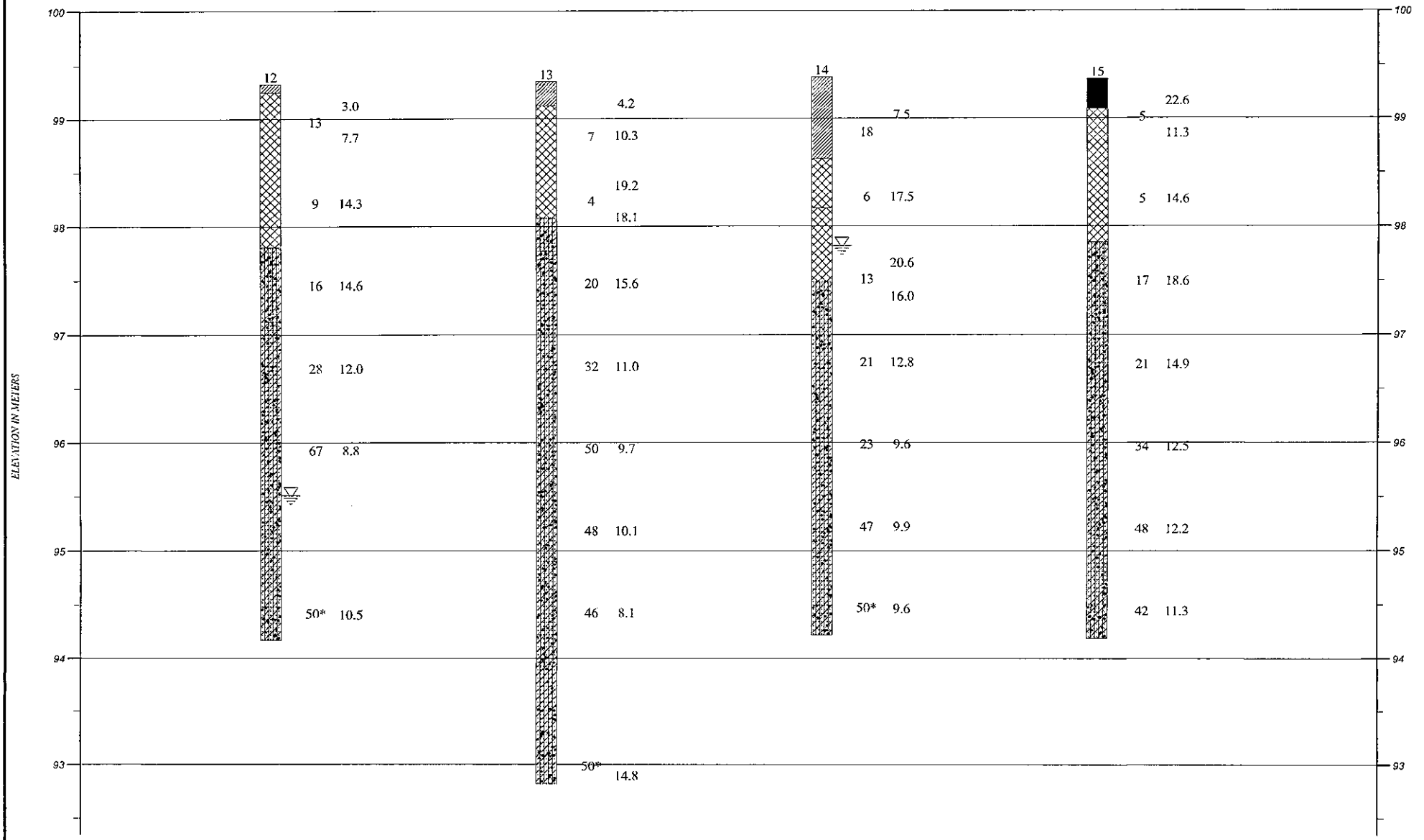
SOLA ENGINEERING INC.

CONCEPTUAL SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	
VERTICAL SCALE: 1"=50'		

Proposed Residential Development

PROJECT NO. 10278 | Enclosure 18



Plan View

Strata symbols

- Pavement
- Fill
- Silty clay till
- Fill clayey
- Clayey silt till
- Clayey silt
- Silty clay
- Topsoil
- Description not given for: "FFF"
- Description not given for: "CZCZ"

SOLA ENGINEERING INC.

CONCEPTUAL SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	
VERTICAL SCALE: 1"=50'		

Proposed Residential Development

PROJECT NO. 10278 | Enclosure 18